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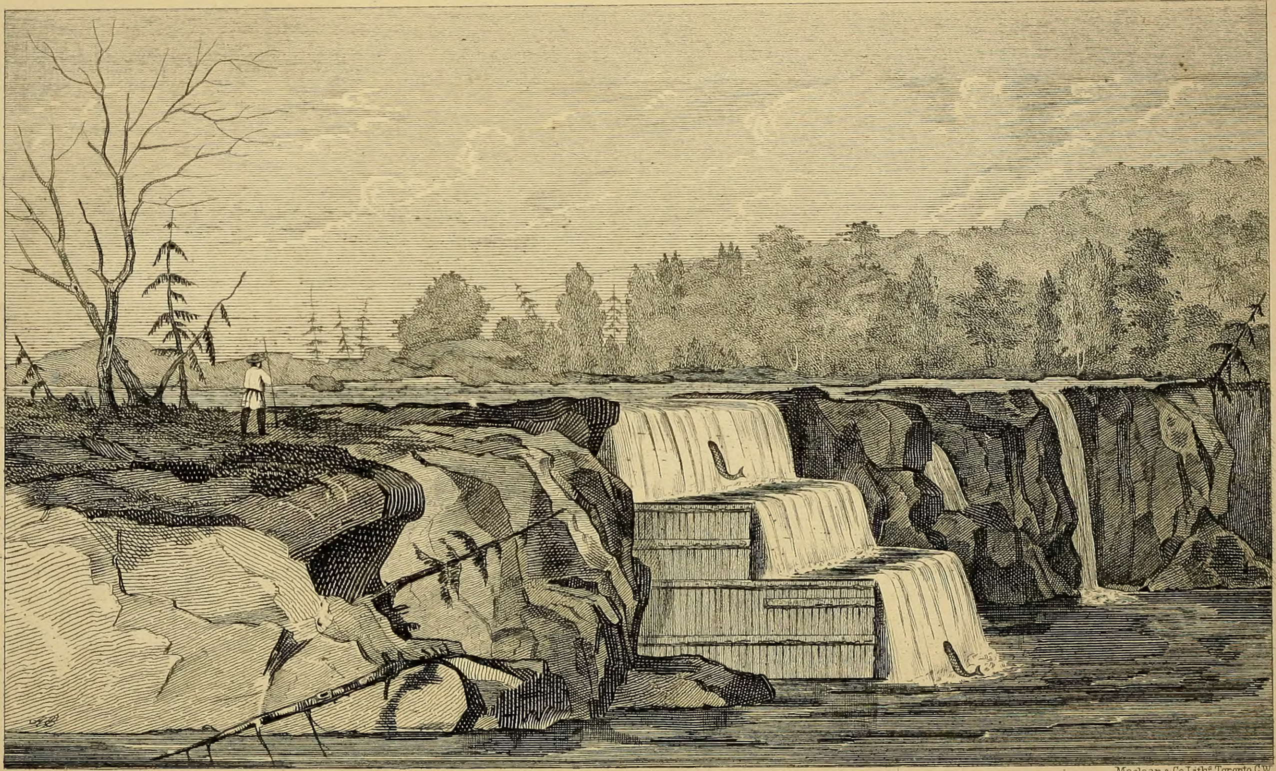
*** *Communications for the Journal to be addressed to the General Editor,* Dr. Wilson, *University College, Toronto.*



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CANADIAN SALMON LEAPS.

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No. VII.—JANUARY, 1857.

THE DECREASE, RESTORATION, AND PRESERVATION OF SALMON IN CANADA.

BY THE REV. WILLIAM AGAR ADAMSON, D.C.L.

Read before the Canadian Institute, December 6th, 1856.

Brillat Savarin, in his "Physiologie du Gout," asserts that the man who discovers a new dish does more for the happiness of the human race than he who discovered the Georgium Sidus. If this be true, then he who could devise means for the preservation and increase of an old, wholesome and highly coveted article of food would not labor in vain, nor would, I imagine, his endeavors be despised by the members of the Canadian Institute, however humble his abilities, and however unskilled he might be in scientific lore. Actuated by this belief, as well as desirous to respond to the demand for co-operation among the members of the Canadian Institute, I would venture to lay before you some notes upon the decrease, restoration, and preservation of the Salmon (*Salmo Salar*) in Canada.

It is unnecessary to magnify the importance of this fish as an economic production, or as an article of commerce. As food it is beyond comparison the most valuable of fresh water fish, both on account of the delicacy of its flavor, and the numbers in which it can be supplied. By prudence, a little exertion, and a very small expense now, it may not only be rendered cheap and accessible to almost every family in Canada, but also an article of no small commercial importance as an export to the United States, in which country, by

pursuing the course which Canada has hitherto imitated, this noble fish has been almost exterminated. Twenty-five or thirty years ago every stream tributary to the St. Lawrence, from Niagara to Labrador on the north side, and to Gaspé basin on the south, abounded with salmon. At the present moment, with the exception of a few in the Jacques Cartier, there is not one to be found in any river between the Falls of Niagara and the city of Quebec. This deplorable decrease in a natural production of great value has arisen from two causes; 1st.—the natural disposition of uncivilized man to destroy at all times and at all seasons whatever has life and is fit for food; and 2nd.—the neglect of those persons who have constructed mill-dams, to attach to them slides, or chutes, by ascending which the fish could pass onwards to their spawning beds in the interior. It is supposed by many that the dust from the sawmills getting into the gills of the salmon prevents them from respirating freely, and so banishes them from the streams on which such mills are situated, but I am persuaded that this is a mistake, for salmon are found in considerable numbers at the mouths of many such streams, below the dams. In the Marguerite, in the Saguenay, at the Petit Saguenays, the Es-quemain, Port Neuf. Rimouski, Metis, and others that might be named, the real cause of the decrease is the insuperable obstacles presented by mill-dams, which prevent them from ascending to the ærated waters, high up the streams, which are essential for the fecundation of their ova, and so for the propagation of the species. Would you then—it may be asked, pull down our mills in order that we might have salmon in our rivers? most certainly not, I reply, for it is quite possible to maintain all our mills, with all their mill-dams, and yet afford to the fish an easy and inexpensive mode of passing upwards to their breeding places.

Marvellous stories are told of the great heights which salmon will leap in order to surmount the obstacles which nature or art may have erected between the lower parts of a stream and the upper waters which are suited to breeding purposes. Natural historians used gravely to tell us that salmon, in order to jump high, were in the habit of placing their tails in their mouths, and then, bending themselves like a bow, bound out of the water to a considerable distance, from twelve to twenty feet. The late Mr. Scrope, in his beautiful book "Days and Nights of Salmon Fishing," calculates that six feet in height is more than the average spring of salmon, though he conceives that very large fish in deep water, could leap much higher. He says, "Large fish can leap much higher than small ones; but

their powers are limited or augmented according to the depth of water they spring from; in shallow water they have little power of ascension, in deep they have the most considerable. They rise very rapidly from the very bottom to the surface of the water by means of rowing and sculling as it were, with their fins and tail, and this powerful impetus bears them upwards in the air, on the same principle that a few tugs of the oar make a boat shoot onwards after one has ceased to row." However this may be, we know that salmon use almost incredible efforts to ascend their native rivers. Modes have recently been adopted in France, in England, Scotland and Ireland, by which they can do so with ease, and which can be much more cheaply applied to Mill-dams in Canada, than in any of the countries above mentioned. This is simply by constructing below each mill-dam a congeries of wooden boxes proportioned to the height of the dam—which could be done, in any weirs I have seen requiring them, for a sum not exceeding twenty dollars. We will suppose that the mill-dam to be passed over is fifteen feet high from the surface of the water, and that the salmon can surmount the height of five feet at a single bound, then it would be only necessary to erect two boxes, each five feet high, one over the other (as in the illustration) to enable the salmon, in three leaps, to reach the waters which nature prompts him to seek for the propagation of his species. In many Canadian rivers—such as Metis, Matane, Rimouski, Trois Saumons, etc.—this simple apparatus might be put in operation for one half the sum I have mentioned, and I trust it has only to be suggested to the gentlemen residing on their banks to arouse their patriotism and excite them to activity in the matter. There can be no doubt that were the mill-dams removed, or boxes constructed adjacent to them, and protection afforded to the spawning fish, many of the rivers in *Upper Canada* would again abound with Salmon. I have myself, within a few years, taken the true Salmo Salar in Lake Ontario, near Kingston, and many persons in Toronto know that they are taken annually at the mouths of the Credit, the Humber and at Bond Head, in the months of May and June, which is earlier than they are generally killed below Quebec. Whether these fish come up the St. Lawrence in the early spring, under the pavement of ice which then rests upon its surface, or whether they have spent the winter in Lake Ontario, is a question which I must leave to naturalists; merely mentioning that there is some foundation for believing that salmon will not only live, but breed, in fresh water, without visiting the sea. Mr. Lloyd, in his interesting work on the field sports of the North of Europe, says,

"Near Katrineberg, there is a valuable fishery for salmon, ten or twelve thousand of these fish being taken annually. These salmon are bred in a lake, and, in consequence of cataracts, cannot have access to the sea. They are small in size and inferior in flavor," which may also be asserted of salmon taken in the neighborhood of Toronto. Mr. Scrope, in his work previously quoted, states that Mr. George Dormer, of Stone Mills, in the Parish of Bridport, put a female of the salmon tribe, which measured twenty inches in length, and was caught by him at his mill-dam, into a small well, where it remained twelve years, became quite tame and familiar, so as to feed from the hand, and was visited by many persons of respectability from Exeter and its neighborhood.

But the fact that salmon are annually taken near the Credit, the Humber and Bond Head is sufficient ground on which to base my argument for the probability that were the tributary streams of the St. Lawrence accessible to them they would ascend and again stock them with a numerous progeny. Even were this found not to be the case,—then we have the system of artificial propagation to fall back upon—a system which according to the Parliamentary Reports of the Fishery Commissioners has been practised with immense success in different parts of Ireland—according to M. Coste, Member of the Institute, and professor of the college of France, in his reports to the French Academy and the French Government, has answered admirably in France, and according to Mr. W. H. Fry and others, quoted by him in his treatise on artificial fish-breeding, has been generally effective in Scotland. This system, as is well known, consists simply of transporting from one river to another the impregnated eggs of the salmon, and placing them in shallow waters with a gentle current where they are soon hatched, and become salmon fry or par and able to take care of themselves. In consequence of the ova of the salmon, which are deposited in the spawning beds in the months of October, November and December, becoming congealed by frost in the subsequent months, Canada appears to offer greater facilities for their safe transport than those countries in which the system has been so successful, but whose climates are more temperate. Surely, supposing this is a mere untried experiment—which is far from being the case—it would be well worth the while of some of the many wealthy and intelligent dwellers upon the banks of our beautiful rivers to test its value, particularly when they call to mind the well known fact in the natural history of the salmon, that he invariably returns to the stream in which his youth was spent, and that so they may calculate

upon having their present barren rivers stocked with as valuable articles of consumption and of commerce as their fowl-houses or their farm-yards.

I shall, for brevity's sake, abstain from enlarging on this subject, merely observing that ample information can be obtained upon it by consulting the works of M.M. Coste and Fry, which are to be found in the libraries and bookshops in this city ; and that in the streams in which it may be put into operation—if there are mill-dams upon them—the artificial construction to enable the fish to descend and ascend to and from the sea will still be requisite.

Having said so much on the decrease and restoration of salmon in Canada, let us now turn our attention for a few moments to their preservation in the rivers in which they still abound. These rivers I believe to be as valuable and inexhaustible as any others upon the face of the globe, but so circumstanced that their capabilities have not been developed, and that one year of neglect will cause their serious injury, if not their utter destruction, as salmon streams. They extend along the northern shore of the St. Lawrence from Quebec to Labrador, a distance of about 500 miles, and are many in number. They are chiefly held under lease from the Government of Canada, by the Hudson's Bay Company, who fish some of them in an unsystematic manner, with standing nets, because they can be conveniently and cheaply so fished, whilst others are left wholly to the destructive spear of the Indian. In the smaller streams on which the fishermen of the company are employed, a series of standing barrier-nets, (which kill indiscriminately every fish of every size and weight,) is used, a process, which in European rivers, would have long since banished salmon from them. But in Canada the high water in the spring enables some of the largest and strongest of the breeding fish to ascend the streams before those nets can be set, and when they get beyond them, they are comparatively safe in the mountain rivers and lakes which never hear a human footfall till winter—which congeals their surfaces into ice—tempts the poor Indian to tread their banks in pursuit of the bear, the marten, the mink and the otter.

In well regulated salmon fisheries in Europe, the fish—by the construction of proper weirs and reservoirs—are almost as much under the control of the managers as the sheep on their farms or the fowl in their poultry-yards. They can send such of them as they please to market, permit the fittest for the purpose to pass on to propagate their kind, allow the young to enjoy life till they become mature, and suffer the sick and unhealthy to return to their invigorating pastures

in the depths of the ocean. But no portion of this system is practised in our American rivers. There is not a salmon weir in the province; and the consequence is, that young and old, kelt and grilse, worthless and unwholesome, the fish are killed by the undiscriminating net and the cruel spear.

It appears to me that the Hudson's Bay Company set little value on these fisheries, and maintain them merely as an accident appertaining to the fur trade which is far more profitable. The approaching termination of their lease and the consequent uncertainty of their tenure may perhaps appear a sufficient reason for their not incurring the expense of erecting weirs, by which much more profit could be made of their fisheries. Unproductive and wasteful as their mode of fishing is, *the protection the Hudson's Bay Company affords is the only present safeguard for the existence of Salmon in Canada.* I am persuaded that *were that protection withdrawn for* ONE SUMMER, *without the substitution of some other as effective, this noble fish would be utterly exterminated from our country.* Fishermen from Gaspé, Rimouski, New Brunswick, Labrador, Newfoundland, the Magdalene Islands and the United States—whose numbers and skill would enable them to do thoroughly what the servants of the H. B. C. from their paucity and inexperience do ineffectually—would swarm up our rivers, and with nets, spears, torches, and every other engine of piscine destruction, would kill, burn and mutilate every fish that ventured into the rivers. Already has this been attempted. For the last two or three years schooners from the United States, have regularly arrived, in the salmon season, at the Bay of Seven Islands, their crews well armed, and have set their nets in the river Moisie, in despite of the officers of the H. B. C. Similar circumstances have occurred at other fishing stations in the tributaries of the St. Lawrence; no means, that I am aware of, having been resorted to for punishing the aggressors or preventing a repetition of their outrages. The river Bersinies has this year (1856) been altogether in the hands of a speculating and rapacious American, who employed the spear of the Indian to furnish him with mutilated salmon, several boxes of which he brought to this city, in the month of September, when they were out of season, unfit for food and flavorless, having previously glutted the markets of Portland, Boston and New York with more palatable fish.

There can be but little doubt that many of the salmon streams in Lower Canada would be as productive, under proper management, as rivers in Europe for which large annual rents are paid; but it must

be admitted that the great distance at which they are situated from Civilization, the want of the means of intercourse between them and the inhabited parts of the country, the liability to trespass by armed ruffians, and the dreadful rigor of the climate in winter, present very serious obstacles to those who might wish to undertake such management: for obviating some of which I see no better method than the employment, during the summer months, of one or two armed steamers of light draught of water, such as are used for a similar purpose on the east coast of Denmark. These steamers should each have a commander on board, who should be a magistrate and empowered by parliament to act summarily in cases of infraction of the Fishery Laws, and beside supplying the lighthouses and other public works with stores, oil, building materials, etc., conveying the workmen managers and fishermen to their several stations, and protecting the lessees of the Province, might also be profitably employed as the means of transporting the fresh caught salmon from the several rivers, packed in ice, to the Rail-road Stations at St. Thomas and Quebec; from whence they could be distributed to the markets of Canada and the United States. Two Bills for the protection of salmon and trout in Lower Canada have recently become Acts of Parliament. These may possibly be productive of some good in civilized and inhabited districts, but must be utterly ineffective in those parts of the Province where there are no settled inhabitants, no magistrates, and no tribunals before which those who infringe the Law can be cited; and this is the case of all the best rivers in Lower Canada.

I cannot close these observations without endeavoring to impress on all who hear me, the necessity for prompt action in this matter; for there can be no doubt upon the mind of any man who is acquainted with the localities, that if the King's Posts should be abandoned by the Hudson's Bay Company, before some well devised system be adopted for carrying on the work which they have hitherto effected, two melancholy results will be the inevitable consequences, viz.—the salmon rivers will be taken possession of by hordes of lawless men, who will in no way contribute to the revenue of the country, but will quickly and recklessly exterminate the fish, and then desert our shores, leaving behind them no trace of their temporary occupation except the destruction they have wrought—and more terrible still—a whole tribe of Indians (the Montagnards) will be reduced to a state of positive starvation, for upon the Hudson's Bay Company they have hitherto been, and are now dependent for their ammunition, guns, and other means by which they obtain their food and clothing.

ON PRESERVING TIMBER FROM DECAY.

BY JOSEPH ROBINSON, TORONTO.

Read before the Canadian Institute, December 20th, 1856.

The economic value of timber, and the immense outlay required for the constant restoration of works executed in the cheaper but least durable varieties of woods, have long directed the attention of practical men to the desirableness of discovering some process by which greater durability could be given to a material, in all other respects so admirably adapted to the objects in view, without affecting its original cost to such an extent as to render it no longer available for the numerous ordinary purposes to which it is now applied. To this subject, attention was anew directed in the last number of the *Canadian Journal*, in an article on the "Preservation of Timber;"* and it may not be out of place, by way of adding to the existing fund of information upon a subject of such general interest, to bring before the Institute, a well attested and valuable process invented and used by the eminent French chemist, Dr. Boucherie.

This process is the result of twenty years experimental labor and study, and is regarded in France and England as of the highest importance, being the only mode yet brought into practical and extensive application, by which the durability of woods, liable to decay, can be economically and effectually secured.

It accomplishes two objects: first, that of expelling the sap; and, secondly, filling the pores of the timber with a preservative solution.

The mode of impregnating trees hitherto adopted, has been by saturation only, assisted sometimes by great pressure, and by previously subjecting the timber in cylinders to a vacuum or to heat.

Dr. Boucherie's process differs entirely: inasmuch as he applies a moderate pressure, and to one end only of the sap tubes of the tree, the effect of which is to expel the sap by the preserving liquor which takes its place. By some of the processes hitherto used, the sap (the fermentation of which is admitted to be the cause of decay) is allowed to remain in the tree; in the process now under review, the sap is expelled, and the tubes are thoroughly cleansed from the fermenting matter, which is displaced by an injected solution of a preservative nature.

The tubular structure of trees has been long known, but it has not

* *Vide* Vol. I., p. 559. New Series,

been known that no connexion exists between the tubes laterally; and this is shewn by the interesting experiment of stopping up or shutting off certain of the sap-tubes at the end of the tree, leaving exposed such as form a word: which word, or name, by the injection of a coloring liquor, can be driven from one end of the tree to the other; so that wherever the tree is cut through, the name appears distinctly in colored letters on the exposed sections.

This experiment is interesting, not only in a scientific point of view; but it shews that none of the processes hitherto used, wherein lateral pressure is involved, can force any preserving liquor into a tree without a degree of violence, which must injure the fibre of the wood, and destroy its strength and use for many purposes.

The advantages which would result from expelling the sap and replacing it by an antisceptic fluid, have been long known; and the idea of effecting this by applying the fluid under pressure at the end of a piece of timber is not new, having been suggested and patented many years ago by Mr. Bethel. But the means then used did not accomplish the object in such a manner as to admit of its commercial application. Hence the more expensive process of creosoting has been adopted; where the timber is totally immersed in the oil, under pressure, a method which does not permit the sap to escape.

By the old process of violent pressure, the preserving liquor is forced at right angles to the tubes through the woody fibre of the tree, injuring its strength as well as its capability, in railway sleepers, for example, to resist the wear of the chairs; consuming at the same time an unnecessary amount of the preserving liquor, without (whatever pressure may be applied) thoroughly impregnating the timber, while one-sixth or one-eighth of the force only is necessary by the new process, and the portion alone requiring the preservative infusion, viz. the soft matter between the rings, is impregnated, the woody fibre remaining unbroken and undisturbed.

Another important advantage in Dr. Boucherie's process, is derived from the simplicity and moderate cost of the apparatus, which, for operations on a small scale, will not exceed £10 or £15, and for a railway of two hundred miles, under £50.

The practical application and entire success of this invention in Europe will be seen by the printed official reports. The first of these was made, by order of the French Government, in the year 1850, the second in 1852, and the third in 1856: being an abstract from the official jury report of the Exposition Universelle of 1855, whereby it will be seen that the distinguished honor of one of the large gold

medals was awarded to Dr. Boucherie, of which only four were conferred in all.

The mode of application is as follows :—Soon after the tree is felled, a saw-cut is made in the centre, through about nine-tenths of its section. The tree is slightly raised by a lever or wedge at its centre, and the saw-cut thereby partially opened ; a piece of string is then placed round the cut, close to the outer circumference of the tree, the support is withdrawn, and the saw-cut closes on the string, thereby making a water-tight joint. An auger-hole is then bored obliquely into the saw-cut ; a wooden tube is driven into the hole, the conical end of which is attached to a flexible pipe, which is in connexion with a cistern or reservoir, at an elevation of from 30 to 40 feet above the tree intended to be preserved.

When it is necessary to prepare timber in long lengths, a cap is placed at the end of the tree by screws or dogs. The most efficacious solution is composed of sulphate of copper and water, mixed in the proportion of 1 to 100. The strength is easily ascertained, by any intelligent workman, by an hydrometer ;—and the cost of such a solution is so trifling, as to offer no impediment to its universal application for the purpose in view.*

It would be difficult to enumerate all the classes to be benefitted by this invention, and the uses to which it may be applied. Railway companies, ship-builders, telegraph companies, and land owners, would alike benefit by it. Post and rail fencing, field gates, wood farm buildings, frame buildings, and dwellings in general, would last many additional years. Mr. R. Stephenson, the President of the Institute of Civil Engineers, in his inaugural address, adverts to the great consumption of railway sleepers by decay, and estimates it at 2,600,-000 per annum, costing upwards of £500,000. Taking the resistance

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* On comparing the above account of Boucherie's process with that described in the *Canadian Journal* (No. 6, pp. 559–561) and for which a patent was taken out in May, 1856, the two processes appear to be identical so far as the employment of hydraulic pressure is concerned, and if such is the case, this part of the patent is void.

The following is the text of the Patent Law bearing upon this point. " If at " the trial in any such action [*for infringement of Patent,*] it shall be made appa- " rent to the satisfaction of the Court....that the thing thus secured by Patent " was not originally discovered by the Patentee, or party claiming to be the " Inventor or Discoverer in the specification referred to in the Patent, but had " been in use, or had been described in some public work, anterior to the supposed " discovery of the Patentee......the Patent shall be declared void." 13 and 14 Vict. " 79, c. 8.—(*Ed. Can. Jour.*)

of the proposed sleepers to decay as the only basis of the calculation, a large proportion of this sum would be saved. Assuming the duration of the sleeper to be doubled, and taking into account the mechanical causes of destruction, a saving of £300,000 per annum, would be effected to the railway interest in England alone.

From these data, the value of the invention in Europe will readily be seen, and although it has been patented in France and England, and, as it would seem, to some extent, in Canada, it is believed that the use in this Province is unfettered; 1st, because by the Statutes of Canada, no foreigner can obtain a patent monopoly in this country; and, 2nd, because, being already known and used in other countries, it cannot be patented here.

THE CHINOOK INDIANS.

BY PAUL KANE, TORONTO.

In accordance with an invitation of the Council of the Canadian Institute to communicate notices of some of the tribes of Indians amongst whom I have travelled, I selected the Chinooks, one of the tribes most remote from this part of the continent, and whose manners and customs are so much at variance with our own, as to render some notice of them, from personal observation, probably both novel and interesting. Other communications of the incidents and results of my travels among the Indians of the North West, having since appeared in the Journal, I have revised my account of the Chinooks, with a view to its appearance, along with the notices of the Walla Wallas, and others of the Aborigines of this continent in the New Series.

The Flat-Head Indians are met with along the banks of the Columbia river from its mouth eastward to the Cascades, a distance of about 130 miles; they extend up the Walamett river south about 30 or 40 miles, and through the district lying between the Walamett and Fort Astoria, now called Fort George. To the north they extend along the Cowlitz river and the tract of land lying between that and Puget's Sound. About two-thirds of Vancouver's Island is also occupied by them, and they are found along the coasts of Puget's Sound and the Straits of Juan de Fuca. The Flat-Heads are divided into numerous tribes, each having its own peculiar locality, and differing more or less from the others in language, customs, and manners.

Of these I have selected, as the subject of the present paper, the Chinooks, a tribe inhabiting the tract of country at the mouth of the Columbia river. Residing among the Flat-Heads, I remained from the fall of 1846 to the following autumn of 1847, and had consequently ample opportunity of becoming acquainted with the peculiar habits and customs of the tribe. They are governed by a Chief called Casenov. This name has no translation: the Indians on the west side of the Rocky Mountains differing from those on the east, in having hereditary names, to which no particuliar meaning appears to be attached, and the derivation of which is in many instances forgotten. Casenov is a man of advanced age, and resides principally at Fort Vancouver, about 90 miles from the mouth of the Columbia. I made a sketch of him while staying there, and obtained the following information as to his history:—Previous to 1829 Casenov was considered a great warrior, and could lead into the field 1,000 men, but in that year the Hudson's Bay Company and emigrants from the United States introduced the plough for the first time into Oregon, and the locality, hitherto considered one of the most healthy, was almost depopulated by the fever and ague.

Chinook Point, the principal settlement of the tribe, at the mouth of the river, where King Cumcomley ruled in 1811, was nearly reduced to one-half its numbers. The Klatsup village now contains but a small remnant of its former inhabitants. Wasiackum, Catlamet, Kullowith, the settlements at the mouth of the Cowlitz, Kallemo, Kattlepootle and Walkumup are entirely extinct as villages. On Sovey's Island there were formerly four villages but now there scarcely remains a lodge. They died of this disease in such numbers that their bodies lay unburied on the river's banks, and many were to be met with floating down the stream. The Hudson's Bay Company supplied them liberally with Quinine and other medicines, but the good effects of these were almost entirely counteracted by their mode of living and obstinacy in persisting in their own peculiar mode of treatment, which consisted principally in plunging into the river without reference to the particular crisis of the disease.

From these causes the numbers of the Indians have been very much reduced, and the effective power of the tribes so greatly diminished that the influence which Casenov owed to the number of his followers has correspondingly declined; his own immediate family consisting of ten wives, four children, and eighteen slaves, being reduced in one year to one wife, one child, and two slaves. Their decrease since that time has also been fearfully accelerated by the introduction of

ardent spirits, which, in spite of prohibition and fines against selling it to Indians, they manage to obtain from their vicinity to Oregon city, where whiskey, or a poisonous compound called there *blue ruin*, is illicitly distilled. I have scarcely ever met with an Indian in that vicinity who would not get drunk if he could procure the means, and it is a matter of astonishment how very small a quantity suffices to intoxicate these unfortunate beings, although they always dilute it largely in order to prolong the pleasure they derive from drinking.

Casenov is a man of more than ordinary talent for an Indian, and he has maintained his great influence over his tribe chiefly by means of the superstitious dread in which they hold him. This influence was wielded with unflinching severity towards them, although he has ever proved himself the firm friend of the white man. For many years, in the early period of his life, he kept a hired assassin to remove any obnoxious individual against whom he entertained personal enmity. This bravo, whose occupation was no secret, went by the name of Casenov's *Skōcoom* or evil genius. He finally fell in love with one of Casenov's wives who eloped with him. Casenov vowed vengeance, but the pair for a long time eluded his search, until one day he met her in a canoe near the mouth of the Cowlitz river and shot her on the spot. After this he lived in such continual dread of the lover's vengeance that for nearly a year he never ventured to sleep, but in the midst of a body guard of forty armed warriors, until at last he succeeded in tracing his foe out, and had him assassinated by the man who had succeeded him in his old office.

The Chinooks over whom Casenov presides carry the process of flattening the head to a greater extent than any other of the Flat-Head tribes. The process is as follows:—The Indian mothers all carry their infants strapped to a piece of board covered with moss or loose fibres of cedar bark, and in order to flatten the head they place a pad on the forehead of the child, on the top of which is laid a piece of smooth bark bound on by a leathern band passing through holes in the board on either side and kept tightly pressed across the front of the head. A sort of pillow of grass or cedar fibres is placed under the back of the neck to support it.

This process commences with the birth of the infant, and is continued for a period of from eight to twelve months, by which time the head has lost its natural shape and acquired that of a wedge, the front of the skull becoming flat, broad, and higher at the crown, giving it a most unnatural appearance.

It might be presumed that from the extent to which this is

carried the operation must be attended with great suffering to the infant, but I never heard the infants crying or moaning, although I have seen their eyes seemingly starting out of the sockets from the great pressure. But on the contrary, when the bandages were removed I have noticed them cry until they were replaced.

From the apparent dullness of the children whilst under the pressure I should imagine that a state of torpor or insensibility is induced, and that a return to consciousness occasioned by its removal must be naturally followed by the sense of pain.

This unnatural operation does not however seem to injure the health, the mortality amongst the Flat-Head children not being perceptibly greater than amongst other Indian tribes. Nor does it seem to injure their intellect; on the contrary, the Flat-Heads are generally considered fully as intelligent as the surrounding tribes who allow their heads to preserve their natural shape; and it is from amongst the round-heads that the Flat-Heads take their slaves. They look with contempt even upon the whites for having round-heads, the *flat-head* being considered as the distinguishing mark of freedom. I may here remark, that, amongst the tribes who have slaves there is always something which conspicuously marks the difference between the slave and the free, such as the Chimseyan, who wear a ring in the nose, and the Babbenes who have a large piece of wood inserted through the under lip. The Chinooks, like all other Indian tribes, pluck out the beard on its first appearance.

I would give a specimen of the barbarous language of these people, were it not impossible to represent by any combination of the letters of our alphabet the horribly harsh, gasping, spluttering sounds which proceed from their throats, apparently unguided either by the tongue or lips. It is so difficult to acquire a mastery of their language that none have been able to attain it unless those who have been born amongst them. They have, however, by their intercourse with the English and French traders succeeded in amalgamating, after a fashion, some words of each of these tongues with their own, and have formed a sort of Patois, barbarous enough certainly, but still sufficient to enable them to communicate with the traders.

This Patois I succeeded, after some short time, in acquiring, and could converse with most of the chiefs with tolerable ease. Their common salutation is *Clah hoh ah yah*, originating, as I believe in their having heard in the early days of the fur trade a gentleman named Clark frequently addressed by his friends, "Clark, how are you?" This salutation is now applied to every white man, their own

language affording no appropriate expression. Their language is also peculiar in containing no oaths, or any words expressive of gratitude or thanks.

Their habits are extremely filthy, their persons abounding with vermin, and one of their chief amusements consists in picking these disgusting insects from each others' heads and eating them. On my asking an Indian one day why he ate them, he replied that they bit him and he gratified his revenge by biting them in return. It may naturally be supposed that they are thus beset from want of combs or other means of displacing the intruders; but this is not the case, they pride themselves on carrying such companions about them, and giving their friends the opportunity of amusing themselves in hunting and eating them.

The costume of the men consists of a musk-rat skin robe, the size of one of our ordinary blankets, thrown over the shoulders, without any breech-cloth, moccassins or leggings. Painting the face is not much practised amongst them except on extraordinary occasions, such as the death of a relative, some solemn feast, or going on a war party. The female dress consists of a girdle of cedar bark round the waist, with a dense mass of strings of the same material hanging from it all around and reaching almost to the knees. This is their sole summer habiliment. They, however, in very severe weather add the musk-rat blanket. They also make another description of blanket from the skin of the wild goose, which is here taken in great abundance. The skin is stripped from the bird with the feathers on, and cut into strips, which they twist so as to have the feathers outwards. This makes a feathered cord, and is then netted together so as to form a blanket, the feathers filling up the meshes, and rendering it a light and very warm covering. In the summer these are entirely thrown aside, not being in any case worn from feelings of delicacy, and the men go quite naked, though the women always wear the cedar petticoat.

The country which the Chinooks inhabit being almost destitute of furs they have little to trade in with the whites. This, coupled with their laziness—probably induced by the ease with which they procure fish, which is their chief subsistence—prevents their obtaining ornaments of European manufacture, consequently anything of the kind is seldom seen amongst them. They, however, wear long strings of small shells found on the coast called Ioquas, and used by them also as money.

A great traffic is carried on amongst all the tribes through the medium of these shells, which are found only at Cape Flattery, at the

entrance to the Straits of De Fuca. They are fished up from the bottom of the sea, and are found an inch and a-half to two inches in length; they are white, slender, hollow, and tapering to a point, slightly curved, and about the size of the stem of an ordinary clay tobacco pipe. They are valuable in proportion to their length, and their value increases according to a fixed ratio, forty shells being the standard number required to extend a fathoms' length, which number is in that case equal in value to a beaver's skin, but if thirty-nine be found long enough to make the fathom it would be worth two beaver skins, if thirty-eight three skins, and so on, increasing one beaver skin for every shell less than the standard number.

The Chinooks evince very little taste in comparison with some of the tribes on the eastern side of the Rocky Mountains, in ornamenting either their persons or their warlike or domestic implements. The only utensils I saw at all creditable to their decorative skill were carved bowls and spoons of horn, and baskets made of roots and grass woven so closely as to serve all purposes of a pail in holding and carrying water. In these they even boil the salmon which constitute their principal food. This is done by immersing the fish in one of the baskets filled with water, into which they throw red hot stones until the fish is cooked, and I have seen fish dressed as expeditiously by them in this way as if done in a kettle over a fire by our own people.

The salmon is taken during the months of June and July in immense numbers in the Columbia river and its tributaries by spearing and with gill nets. They have also a small hand net something like our common landing net, which is used in rapids where the salmon are crowded together and near the surface. These nets are ingeniously contrived, so that when a fish is in them his own struggles loosen a little stick which keeps the mouth of the net open while empty, but which, when the net is full, immediately draws it together like a purse with the weight of the salmon and effectually secures the prey.

The salmon taken during this period of the year are split open and dried in the sun for their winter's supply. I have never seen salt made use of by any tribe of Indians for the purpose of preserving food, and they all evince the greatest dislike to salt meat.

I may here mention a curious fact respecting the salmon of the Columbia river; they have never been known to rise to a fly, although it has been frequently tried by gentlemen of the Hudson's Bay Company, with the very best tackle. The salmon go up the river as far as they possibly can and into all its tributary streams in myriads; it is, however, a well known fact that after spawning they never

return to the sea, but all die in the river; the Columbia is hardly ever free from gill nets, and no salmon has ever been taken returning; and in the fall, wherever still water occurs, the whole place is tainted by their putrid bodies floating in immense masses. I have been obliged to travel through a whole night trying to find an encampment free from their disgusting effluvia.

The Chinooks also catch a considerable number of sturgeon, which here attain to an enormous size, weighing from four to six cwt.; this is done by means of a long-jointed spear handle seventy or eighty feet in length, fitted into, but not actually fastened to a barbed spear-head, to which is attached a line, with this they feel along the bottom of the river, where the sturgeon are found lying at the spawning season. Upon feeling the fish the barbed spear is driven in and the handle withdrawn. The fish is then gradually drawn in by the line, which being very long allows the sturgeon room to waste his great strength, so that he can with safety be taken into the canoe or towed ashore.

At the mouth of the river a very small fish, about the size of our Sardine, is caught in immense numbers. It is called there Uhlékun, and is much prized on account of its delicacy and extraordinary fatness. When dried this fish will burn from one end to the other with a clear steady light like a candle. The Uhlékuns are caught with astonishing rapidity by means of an instrument about seven feet long; the handle is about three feet, into which is fixed a curved wooden blade about four feet, somewhat the shape of a sabre, with the edge at the back. In this edge, at the distance of an inch and a-half, are inserted sharp bone teeth about an inch long. The Indian standing in the canoe draws this edgeways with both hands, holding it like a paddle, rapidly through the dense shoals of fish which are so thick that almost every tooth will strike a fish. One knock across the thwarts safely deposits them in the bottom of the canoe. This is done with such rapidity that the Indians will not use nets for this description of fishing.

There are few whales now caught on the coast, but the Indians are most enthusiastic in the chase. Upon a whale being seen blowing in the offing they rush down to their large canoes and push off, with ten or twelve men in each. The canoes are furnished with a number of strong seal skin bags filled with air, and made with great care and skill, capable of containing about ten gallons. To each bag is attached a barbed spear-head by a strong string about eight or nine feet long, and in the socket of the spear-head is fitted a handle five or

six feet in length. Upon coming up with the whale, the barbed heads, with the bags attached, are driven into it and the handles withdrawn. The attack is continually renewed until the whale is no longer able to sink from the buoyancy of the bags, when he is despatched and towed ashore. The blubber of the whale is much prized amongst them, and is cut into strips about two feet long and four inches wide, and eaten generally with their dried fish.

Clams and oysters are very abundant, and seals, wild ducks and geese, are taken in great plenty, but their fishing is so productive that the Indians subsist with little labour. They are also very fond of herrings' roe, which they collect in the following manner :—They sink cedar branches to the bottom of the river, in shallow places, by placing upon them a few heavy stones, taking care not to cover the green foliage, as the fish prefer spawning on anything green, and they literally cover all the branches by next morning with spawn. The Indians wash this off in their water-proof baskets, to the bottom of which the roe sinks ; this is squeezed by the hands into little balls and then dried, and is very palatable.

The only vegetables in use amongst the Chinooks are the Camas and Wappattoo. The Camas is a bulbous root much resembling the onion in outward appearance but is more like the potato when cooked and is very good eating. The Wappattoo is somewhat similar but larger and not so dry or delicate in its flavour. They are found in immense quantities in the plains in the vicinity of Fort Vancouver, and in the spring of the year present a most curious and beautiful appearance, the whole surface presenting an uninterrupted sheet of bright ultramarine blue from the innumerable blossoms of these plants. They are cooked by digging a hole in the ground, then putting down a layer of hot stones, covering them with dry grass, on which the roots are placed ; they are then covered with a layer of grass, and on the top of this they place earth, with a small hole perforated through the earth and grass down to the vegetables. Into this they pour water, which, reaching the hot stones, forms sufficient steam to completely cook the roots in a short time, the hole being immediately stopped up after the introduction of the water. They often adopt the same ingenious process for cooking fish, meat, and game.

There is another article of food made use of amongst them, which from its disgusting nature I should have been tempted to omit, were it not a peculiarily characteristic trait of the Chinook Indian, both from its extraordinary character, and its use being confined solely to this tribe ; it is, however, regarded only as a luxury and not as a general

article of food. The whites have given it the name of Chinook Olives, and it is prepared as follows :—About a bushel of acorns are placed in a hole dug for the purpose close to the entrance of the lodge or hut, and covered over with a thin layer of grass, on top of which is laid about half a foot of earth; every member of the family for the next five or six months regards this hole as the special place of deposit for urine, which is on no occasion to be diverted from its legitimate receptacle. Even should a member of the family be sick and unable to reach it for this purpose, the fluid is carefully collected and carried thither. However disgusting such an cdoriferous preparation would be to people in civilized life the product is regarded by them as the greatest of all delicacies; so great indeed is the fondness they evince for this horrid preparation that even when brought amongst civilized society they still yearn after it and will go any distance to obtain it. A gentleman in charge of Fort George had taken to himself a wife, a woman of this tribe, who of course partook with himself of the best food the Fort could furnish; notwithstanding which, when he returned home one day his nostrils where regaled with a stench so nauseating that he at once enquired where she had deposited the Chinook olives, as he knew that nothing else could poison the atmosphere in such a manner. Fearful of losing her dearly-prized luxury she strenuously denied their possession: his nose however, led him to the place of deposit, and they were speedily consigned to the river. His mortification was afterwards not a little increased by learning that she had purchased the delicacy with one of his best blankets.

During the season the Chinooks are gathering Camas and fishing, they live in lodges constructed by means of a few poles covered with mats made of rushes, which can be easily moved from place to place; but in the villages they build permanent huts of split cedar boards. Having selected a dry place for the village, a hole is dug about three feet deep and about twenty feet square: round the sides of this, square cedar boards are sunk and fastened together with cords and twisted roots, rising about four feet above the outer level; two posts are sunk at the middle of each end with a crutch at top, on which the ridge pole rests, and boards are laid from thence to the top of the upright boards. Fastened in the same manner round the interior are erected sleeping places, one above another, something like the berths in a vessel, but larger. In the centre the fire is made, the smoke of which escapes by means of a hole left in the roof for that purpose. These lodges are filthy beyond description and swarm with vermin. The fire is procured by means of a flat piece of dry cedar, in which a small hol-

low is cut, with a channel for the ignited charcoal to run over; this piece the Indian sits on, to hold it steady, while he rapidly twirls a round stick of the same wood between the palms of his hands with the point pressed into the hollow of the flat piece. In a very short time sparks begin to fall through the channel upon finely frayed cedar bark placed underneath, which they soon ignite. There is a great deal of knack in doing this, but those who are used to it will light a fire in a very short time. The men usually carry these sticks about with them, as after they have been once used they produce the fire quicker.

The only warlike implements I have seen amongst the Chinooks were bows and arrows. The bows are made from the Yew tree, and the arrows are feathered and pointed with sharp bone. These they use with great precision.

Their canoes are hollowed out of the cedar, and some of them are very large, as this tree grows to an immense size in the neighbourhood. They make them exceedingly light, and from their formation they are capable of withstanding very heavy seas.

Slavery is carried on to a great extent along the North-West coast and in Vancouver's Island; and the Chinooks, considering how much they themselves have been reduced in numbers, still retain a large number of slaves. These are usually procured from the Chastay tribe who live near the Umqua, a river south of the Columbia emptying into the Pacific. They are sometimes seized by war parties, but are often bought from their own people. They do not flatten the head, nor is the child of one of them (although by a Chinook father,) allowed this distinguishing mark of freedom. Their slavery is of the most abject description: the Chinook men and women treat them with great severity, and exercise the power of life and death at pleasure. An instance of the manner in which the Chastay slaves are treated presented itself to my own observation one morning while I was out sketching on Vancouver's Island. I saw upon the rocks the dead body of a young woman whom I had seen a few days previously walking about in perfect health, thrown out to the vultures and crows. I mentioned it to a gentleman of the Hudson's Bay Company, who accompanied me to the lodge she belonged to, where we found an Indian woman, her mistress, who made light of her death, and who was no doubt the cause of it. She said a slave had no right to burial. She was furious on being told that the slave was as good as herself. "She, the daughter of a chief, no better than a slave!" She then stalked out of the lodge with great dignity; the next morning she had taken

down the lodge and was gone. I was also told by an eye witness, of a chief who, having erected a colossal idol of wood, sacrificed five slaves to it, barbarously murdering them at its base, and asking in a boasting tone who among them could afford to kill so many slaves. One of these slaves was a handsome girl who had lived from her infancy in his family, and begging most piteously for life, reminded him of the care she had taken of his children and all the services she had rendered; but her pleadings were of no avail, and the brutal wretch with his own hand plunged a knife four times into her body before she ceased her appeals for mercy. The only distinction made in her favour was that she was buried, instead of being, like her miserable companions, thrown out on the beach.

The principal amusement of the Chinooks is gambling, which is carried to great excess amongst them. You never visit the camp but you hear the monotonous gambling song of "he ha, ha," accompanied by the beating of small sticks on some hollow substance. Their games do not exceed two or three, and are of a simple nature. The one most generally played consists in holding in each hand a small piece of stick the thickness of a goose quill and about an inch and a-half in length, one plain and the other distinguished by a little thread wound round it, the opposite party being required to guess in which hand the marked stick is to be found. A Chinook will play at this simple game for days and nights together, until he has gambled away everything he possesses, even his wife. They play, however, with much equanimity, and I never saw any ill-feeling evinced by the loser against his successful opponent. They will cheat if they can, and pride themselves on its success; if detected no unpleasant consequence follows, the offending party being merely laughed at and allowed to amend his play.

Another game to which the Chinooks are very partial is played by two or three on each side. The rivals sit on the ground opposite each other with the stakes lying in the centre, one begins with his hands on the ground in which he holds four small sticks covered from sight by a mat, these he arranges in any one of a certain number of forms prescribed by the rules of the game, and his opponent on the opposite side endeavours to guess which form he has chosen; if successful a mark is stuck up in his favour, and the sticks are handed to the next, if not the player counts and still goes on till discovered. When those on one side have gone through, the others commence. At the conclusion the marks are counted and the holder of the greater number wins. This game is also accompanied by singing, in which all the bystanders join.

Another game which I have seen amongst them is called Al-kol-loch, and is one that is universal along the Columbia river. It is considered the most interesting and important as it requires great skill. A smooth level piece of ground is chosen, and a slight barrier of a couple of sticks laid lengthways is made at each end. These are forty or fifty feet apart and a few inches high. The two opponents, stripped naked, are armed each with a very slight spear about three feet long and finely pointed with bone. One of them takes a ring made of bone or some heavy wood, about three inches in diameter, and wound round with cord, on the inner circumference of which are fastened six beads of different colours at equal distances, to each of which a separate numerical value is attached; the ring is then rolled along the ground to one of the barriers and is followed at the distance of two or three yards by the players, and as the ring strikes the barrier and is falling on its side the spears are thrown so that the ring may fall on them; if only one of the spears should be covered by the ring the owner of it counts according to the coloured bead over it. But it generally happens, from the dexterity of the players, that the ring covers both spears, and each count according to the colours of the beads above his weapon. They then play towards the other barrier, and so on until one party has attained the number agreed upon for game.

The Chinooks have tolerably good horses, and are fond of racing, at which they bet considerably; they are expert jockeys and ride fearlessly. They also take great delight in a game with a ball, which is played by them in the same manner as by the Cree, Chippewa, and Sioux Indians. Two poles are erected about a mile apart, and the company is divided into two bands armed with sticks, having a small ring or hoop at the end, with which the ball is picked up and thrown to a great distance, each party then strives to get the ball past their own goal. There are sometimes hundreds on a side, and the play is kept up with great noise and excitement. At this game they also bet heavily, as it is generally played between tribes or villages.

The sepulchral rites of this singular tribe of Indians are too curious to be entirely omitted. Upon the death of a Chinook the body is securely tied up in rush matting and placed in the best canoe they can procure, without any peculiar ceremonies. This canoe is as highly decorated as the family of the deceased can afford. Tin cups, kettles, plates, pieces of cotton, red cloth, and furs, and in fact everything which they themselves most value, and which are most difficult for them to obtain, are hung round the canoe; inside, beside the body

they place paddles, spears, bows and arrows, and food, with everything else which they consider necessary for a very long journey. I have even found beads, Ioquas shells, brass buttons, and small coins in the mouths of the skeletons. The canoe is then taken to the burial place of the tribe, generally selected for its isolated situation. The two principal places are rocky islands in the lower part of the Columbia River. One is called Coffin Rock from the appearance it presents, covered with the raised biers of the deceased members of the tribe. To these they tow the canoe, which is then either fastened up in a tree or supported on a sort of frame four or five feet from the ground made of strong cedar boards, and holes bored in the bottom of the canoe to let the water run out; it is then covered with a large piece of bark to protect it from the rain. Before leaving, the usefulness of every article left with the corpse is destroyed, by making holes in the kettles, cans, and baskets, cracking the bows, arrows, and spears, and if there is a gun they take the lock off, believing that the Great Spirit will mend them upon the deceased arriving at the hunting grounds of their Elysium. The greatest crime which an Indian can commit in the eyes of his people is that of desecrating one of these canoes, and it very seldom happens that the slightest thing is removed.

In obtaining a specimen of one of the peculiarly formed skulls of the tribe I had to use the greatest precaution, and ran no small risk not only in getting it, but in having it in my possession afterwards. Even the voyageurs would have refused to travel with me had they known that I had it among my collections, not only on account of the superstitous dread in which they hold these burial places, but also on account of the danger arising from a discovery, which might have cost the lives of the whole party.

A few years before my arrival at Fort Vancouver, Mr. Douglass, who was then in charge, heard from his office in the Fort the report of a gun inside the gates; this being a breach of discipline he hurried out to enquire the cause of so unusual a circumstance, and found one of Casenov's slaves standing over the body of an Indian whom he had just killed, and in the act of reloading his gun with apparent indifference, Casenov himself standing by. On Mr. Douglass arriving at the spot, he was told by Casenov, with an apology, that the man deserved death according to the laws of the tribe, who, as well as the white man inflicted punishment proportionate to the nature of the offence. In this case the crime was one of the greatest an Indian could be guilty of, namely, the robbing the sepulchre canoes. Mr.

Douglass after severely reprimanding him allowed him to depart with the dead body.

Sacred as the Indians hold their burial places, Casenov himself, a short time after the latter occurrence, had his only son buried in the cemetery of the fort. He died of consumption—a disease very frequent amongst all Indians—proceeding no doubt from their constant exposure to the sudden vicissitudes of the climate. The coffin was made sufficiently large to contain all the necessaries supposed to be required for his comfort and convenience in the world of spirits. The chaplain of the fort read the usual service at the grave, and after the conclusion of the ceremony, Casenov returned to his lodge, and the same evening attempted, as narrated below, the life of the bereaved mother, who was the daughter of the great chief generally known as King Comcomly, so beautifully alluded to in Washington Irving's "Astoria." She was formerly the wife of a Mr. McDougall, who bought her from her father for, as it was supposed, the enormous price of ten articles of each description, guns, blankets, knives, hatchets, &c., then in Fort Astoria. Comcomly, however, acted with unexpected liberality on the occasion by carpeting her path from the canoe to the Fort with sea otter skins, at that time numerous and valuable, but now scarce, and presenting them as a dowry, in reality far exceeding in value the articles at which she had been estimated. On Mr. McDougall's leaving the Indian country she became the wife of Casenov.

It is the prevailing opinion of the chiefs that they and their sons are too important to die in a natural way, and whenever the event takes place they attribute it to the malevolent influence of some other person, whom they fix upon, often in the most unaccountable manner, frequently selecting those the most dear to themselves and the deceased. The person so selected is sacrificed without hesitation. On this occasion Casenov selected the afflicted mother, notwithstanding she had during the sickness of her son been most assiduous and devoted in her attentions to him, and of Casenov's several wives she was the one he most loved; but it is the general belief of the Indians on the west side of the mountains, that the severer the privation they inflict upon themselves the greater is therefore the manifestation of their grief, and the more pleasing to the departed spirit. Casenov assigned to me, as an additional motive for his wish to kill his wife, that as he knew she had been so useful to her son and so necessary to his happiness and comfort in this world, he wished to send her with him as his companion on his long journey. She, how-

ever, escaped into the woods, and next morning reached the Fort, imploring protection ; she was accordingly secreted for several days until her own relations took her home to Chinook Point. In the meantime a woman was found murdered in the woods and the act was universally attributed to Casenov or one of his emissaries.

I may here mention a painful occurence which took place on Thompson's River, in New Caledonia, in further illustration of this peculiar superstition. A Chief dying, his widow considered a sacrifice as indispensable, but having selected a victim of rather too much importance, she was unable for some time to accomplish her object ; at length the nephew of the chief, no longer able to bear the continual taunts of cowardice which she unceasingly heaped upon him, seized his gun and started for the Company's Fort on the river, about twenty miles distant. On arriving, he was courteously received by Mr. Black, the gentleman in charge of the Fort, who expressed great regret at the death of his old friend the chief. After presenting the Indian with something to eat, and giving him some tobacco, Mr. Black turned to leave the room, and while opening the door was shot from behind by his treacherous guest and immediately expired. The murderer succeeded in escaping from the Fort, but the tribe, who were warmly attached to Mr. Black, took his revenge upon themselves and hunted him down. This was done more to evince their high esteem for Mr. Black than from any sense of impropriety in the customary sacrifice.

I never heard any traditions amongst the Chinooks as to their former origin, although such traditions are common among the Indian tribes on the east side of the Rocky mountains. They do not believe in any future state of punishment, although in this world they suppose themselves exposed to the malicious designs of the Sköcoom or evil genius, to whom they attribute all their misfortunes and ill luck. The good spirit is called the *Hias Soch-a-li Ti-yah*, that is the Great High Chief from whom they obtain all that is good in this life, and to whose happy and peaceful hunting grounds they believe they shall all eventually go, to reside for ever in comfort and abundance.

The medicine men of the tribe are supposed to possess a mysterious influence with these two spirits, either for good or evil, and of course possess great power in the tribe. These medicine men form a secret society, the initiation into which is accompanied with great ceremony and much expense. I witnessed, whilst amongst them, the initiation of a canditate, which was as follows :—The canditate has to

prepare a feast for his friends and all who choose to partake of it, and make presents to the other medicine men. A lodge is prepared for him, which he enters, and remains alone for three days and nights, without food, whilst those already initiated keep dancing and singing round the lodge during the whole time. After this fast which is supposed to endue him with wonderful skill, he is taken up apparently lifeless and plunged into the nearest cold water, where they rub and wash him until he revives. This they call "washing the dead." As soon as he revives he runs into the woods, and soon returns dressed as a medicine man, in a costume which generally consists of the light down of the goose stuck all over the body and head with thick grease, and a mantle of friezed cedar bark. With the medicine rattle in his hand he now collects all his property, blankets, shells and ornaments, and distributes the whole amongst his friends, trusting for his future support to the fees of his profession. The dancing and singing are still continued with great vigour during the division of the property, at the conclusion of which the whole party again sit down to feast, apparently with miraculous appetites, the quantity of food consumed being perfectly incredible.

I witnessed one day their mode of treatment of the sick whilst passing through a village. Hearing a horrible noise in one of the lodges, I entered it, and found an old woman supporting one of the handsomest girls of the tribe I had ever seen; cross-legged and naked in the middle of the room sat the medicine man with a wooden dish full of water before him, and twelve or fifteen other men sitting round the lodge. The object in view was to cure the girl of a disease affecting her side. As soon as my presence was noticed a space was cleared for me to sit down. The officiating medicine man appeared in a state of profuse pespiration from the exertions he had used, and soon took his seat amongst the rest as if quite exhausted; a younger medicine man then took his place in front of the bowl and close beside the patient; throwing off his blanket he commenced singing and gesticulating in the most violent manner, whilst the others kept time by beating with little sticks on hollow wooden bowls and drums, singing continually. After exercising himself in this manner for about half an hour, until the pespiration ran in streams down his body, he darted suddenly upon the young woman catching hold of her side with his teeth and shaking her for a few minutes, as one dog does another in fighting. The patient seeming to suffer great agony. He then relinquished his hold, and cried out he had got it, at the same time holding his hands to his mouth, after which he plunged

them in the water, and pretended to hold down with great difficulty the disease which he had extracted lest it might spring out and return to its victim. At length having obtained the mastery over it, turning himself round to me in an exulting manner, he held something up between the finger and thumb of each hand, which had the appearance of a piece of cartilage, whereupon one of the Indians sharpened his knife and divided it in two, leaving one end in each hand. One of the pieces he threw into the water and the other into the fire, accompanying the action with a diabolical noise which none but a medicine man can make; after which he got up perfectly well satisfied with himself, although the poor patient seemed to me anything but relieved by the violent treatment she had undergone.

My principal object in travelling among the Indian tribes of the Far West was to obtain accurate sketches of their Chiefs, medicine men, &c., and representations of their most characteristic manners and customs, but it was only by great persuasion that I could induce the Indians to allow me to take their portraits. They had an undefined superstitious dread of losing something by the process, as though in taking their likeness something pertaining to themselves was carried off. The women, moreover, had the idea that the possessor of their picture would hold an unlimited influence over them. In one case I had taken the likeness of a woman at the Cowlitz river, and on my return about three months afterwards, I called at the lodge of Kisscox, the chief of the tribe, where I had been in the habit of visiting frequently, and had always been received with great kindness, but on this occasion I found him and his family unusually distant in their manner, and the children even running away from me and hiding; at last he asked me if I had not taken the likeness of a woman when last amongst them, I said I had, and mentioned her name, "Cawitchum," a dead silence ensued, nor could I get the slightest answer to my enquiries. Upon leaving the lodge I met a half-breed, who told me that Cawitchum was dead, and that I was supposed to be the cause of her death. The silence was occasioned by my having mentioned a dead person's name, which is considered disrespectful to the deceased, and unlucky. I immediatly left the neighbourhood, well knowing the danger that would result from my meeting with any of her relations.

Upon trying to persuade another Indian to sit for his likeness he asked me repeatedly if it would not endanger his life. Being very much in want of tobacco he at length appeared convinced by my assurances that it could do him no harm, but when the picture was

finished he held up the tobacco and said it was a small piece to risk his life for. I asked another Indian while he was sitting in his lodge surrounded by his eight wives, for the same favor, but the ladies all commenced violently jabbering at me until I was glad to get off: he apparently was much gratified at the interest which his wives took in his welfare. I however met him alone some short time afterwards and got him to consent, with my usual bribe, a piece of tobacco. I could relate numerous instances of this superstitious dread of portrait painting, but the foregoing sufficiently illustrates the general feeling on the subject.

I shall conclude this paper by relating a legend told me by an old Indian while paddling in a canoe past an isolated rock on the shores of the Pacific, as it gives an idea of the general character of the legends on the coast, which are however very few, and generally told in an unconnected and confused manner. The rock with which the following Indian legend is associated, rises to a height of between six and seven feet above the water, and measures little more than four feet in circumference. I could not observe any very special peculiarity in the formation of this rock while paddling past it in a canoe; and, at least from the points of observation presented to my eye, no resemblance to the human figure—such as the conclusion of the legend might lead us to anticipate,—appeared to be traceable. Standing, however, as this rock does, entirely isolated, and without any other visible for miles around, it has naturally become an object of special note to the Indians, and is not uncalculated, from its solitary position, to be made the scene of some of the fanciful creations of their superstitous credulity.

"It is many moons since a Nasquawley family lived near this spot. It consisted of a widow with four sons; one of them was by her first husband, the other three by her second. The three younger sons treated their elder brother with great unkindness, refusing him any share of the produce of their hunting and fishing; he, on the contrary, wishing to conciliate them, always gave them a share of his spoils. He in fact was a great medicine man, although this was unknown to them, and being tired of their harsh treatment, which no kindness on his part seemed to soften, he at length resolved to retaliate. He accordingly one day entered the lodge where they were feasting and told them that there was a large seal a short distance off. They instantly seized their spears and started in the direction he pointed out, and coming up to the animal the eldest drove his spear into it. This seal was 'a great medicine,' a familiar of the

elder brother who had himself created it for the occasion. The foremost of them had no sooner driven in his spear than he found it impossible to disengage his hand from the handle or to draw it out; the two others drove in their spears and with the like effect. The seal now took to the water, dragging them after it, and swam far out to sea. Having travelled on for many miles they saw an island in the distance, towards which the seal made; on nearing the shore they found that they could, for the first time, remove their hands from their spears; they accordingly landed, and supposing themselves in some enemies' country, they hid themselves in a clump of bushes from observation. While lying concealed they saw a diminutive canoe coming round a point in the distance, paddled by a very little man, who, when he came opposite to where they were, anchored his boat with a stone attached to a long line, without perceiving them. He now sprang over the side, and diving down, remained a long time under water, at length he rose to the surface and brought with him a large fish, which he threw into the boat; this he repeated several times, each time looking in to count the fish he had caught. The three brothers being very hungry, one of them offered to swim out while the little man was under water and steal one of the fish; this he safely accomplished before the return of the fisherman, but the little fellow no sooner returned with another fish than he discovered that one of those already caught was missing, and stretching out his hand he passed it slowly along the horizon, until it pointed directly to their place of concealment. He now drew up his anchor and paddled to the shore, and immediately discovered the three brothers; and being as miraculously strong as he was diminutive, he tied their hands and feet together and throwing them into his canoe, jumped in and paddled back in the direction from whence he had come. Having rounded the distant point where they first descried him, they came to a village inhabited by a race of people as small as their captor, their houses, boats, and utensils being all in proportion to themselves. The three brothers were taken out and thrown bound as they were into a lodge, while a council was convened to decide upon their fate. During the sitting of the council an immense flock of birds resembling geese, but much larger, pounced down upon the inhabitants and commenced a violent attack. These birds had the power of throwing their sharp quills like the porcupine, and though the little warriors fought with great valour they soon became covered with the piercing darts, and all sunk insensible on the ground; when all resistance had ceased the birds took to flight and disap-

peared. The three brothers had witnessed the conflict from their place of confinement, and with much labour had succeeded in releasing themselves from their bonds, when they went to the battle ground and commenced pulling the quills from the apparently lifeless bodies, but no sooner had they done this than all instantly returned to consciousness. When all of them had become well again they wished to express their gratitude to their preservers and they offered to grant whatsoever they should desire. The three brothers therefore requested to be sent back to their own country. A council was accordingly called to decide upon the easiest mode of doing so, and they eventually determined upon employing a whale for the purpose. The three brothers were then seated upon the back of the monster and proceeded in the direction of Nasquawley : however, when they had reached about half way the whale began to think what a fool he was for carrying them instead of turning them into porpoises and letting them swim home themselves. Now the whale being a "Soch-a-li-Tiyah" or great spirit—that is the highest of all animal spirits—but of course inferior to the "Hias Soch-a-li Tiyah," who is the Great Spirit over all things, was able to do this at will, and he accordingly tnrned the three brothers into porpoises. This therefore is the way that the porpoises first came into existence, and accounts for their being constantly at war with the seals, one of which species was the cause of their first misfortunes. After the three brothers had so strangely disappeared their mother came down to the beach and remained there for days watching for their return and bewailing their absence with tears. While thus engaged one day the whale happened to pass by and taking pity on her distress he turned her into that stone."

NOTE ON THE OXALATE OF MANGANESE.

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Read before the Canadian Institute, December 20th, 1856.

In Gmelin's Handbuch, Vol. IV., the oxalate of the protoxide of manganese is described as having been obtained by Graham, combined with 5 equivalents (24,16 per cent.) of water, by precipitation

of a solution of one part of manganese-salt in 100 of water, by means of oxalate of potassa; and this compound is stated to lose no water at 212°.F. Nothing is said with regard to the amount of water in the precipitate obtained from concentrated manganese solutions by oxalic acid.

There is evidently some error in the above statement, for the formula MnO, C^2O^3+5 HO requires 38,60 per cent. of water, and Mn O, C^2O^3+3 HO requires 27.39.

In the 89th volume of the Annalen der Chemie and Pharmacie, Hausmann and Löwenthal give an analysis of the oxalate obtained by acting on freshly precipitated carbonate of manganese with oxalic acid, from which they deduce the formula Mn O, C^2O^3+2 HO, for the salt dried at 212°. F.

The following experiments were made for the purpose of explaining the discrepancy.

Strong solutions of sulphate of manganese were precipitated by saturated solutions of oxalic acid, a granular white precipitate was obtained in both cases, which did not lose water at 212°. F. I. and II.

Similar solutions were mixed when boiling. III.

Sulphate of manganese was dissolved in 30 parts of water, and oxalic acid added, a light pinkish crystalline precipitate was formed after a time, which, in the course of a few days, changed into a perfectly white granular powder. IV.

Sulphate of manganese was dissolved in 30 parts of water, and a solution of oxalate of potassa added, a light pinkish crystalline precipitate gradually formed, having the appearance and lightness of benzoic acid, it absorbed and retained water like a sponge, and remained unchanged in the air at ordinary temperatures, but became perfectly white at 212°. F. V.

Sulphate of manganese was dissolved in 100 parts of water, and oxalate of potassa added; the same pink salt was obtained. VI. This should be the compound described by Graham, with 5 HO.

WHITE SALT.

I.	1.391	grms.	gave	0.5890	Mn^3O^4	= 39.38	per cent. MnO
II.	1.292	"	"	0.5566	"	= 40.07	" "
III.	1.717	"	"	0.7510	"	= 40.68	" "
IV.	1.295	"	"	0.5545	"	= 39.83	" "
					Mean	39.99.	

The formula MnO, C^2O^3+2 HO requires 39.72.

PINK SALT.

V.	1.0575	grms.	gave	0.418	Mn^3O^4	= 36.77	per	cent.	MnO
	1.3700	"	"	0.536	"	= 36.79	"		"
VI.	1.4395	"	"	0.567	"	= 36.64	"		"
	1.5300	"	"	0.597	"	= 36,39	"		"
					Mean	36.62.			

1.5300 heated to 212°.F. lost 0.134 HO = 8.75 per cent. HO, and became perfectly white.

The formula MnO, C^2O^3+3 HO requires 36.09 per cent. MnO and one equivalent of water would = 9.09 per cent.

The red oxide of manganese is obtained by heating this salt, in a crystalline form ; the complete conversion of the protoxide into the red oxide is only effected after a rather long roasting.

Burin du Buisson is of opinion that pure salts of the protoxide of manganese are colourless when in an anhydrous state, but reddish when hydrated, while Reithner and others ascribe the red colour to the presence of a salt of the sesquioxide. The pink colour of the above hydrate can scarcely be owing to the latter cause, inasmuch as the salt is produced both by oxalic acid and by oxalate of potash; and the salt with 2 HO is generally obtained perfectly white. (This salt is described by Liebig as having a tinge of pink, but in my experiments it was always white.) The pink crystallized salt changes in a warm atmosphere, even when kept in a close vessel, into the white compound, evolving water.

The oxalate dissolves readily in a hot solution of oxalate of ammonia, and crystalline compounds can be obtained as already described by Winkelblech: these crystalline crusts, however, seem to vary much in their composition, and are probably combinations of the true double salt with variable proportions of oxalate of ammonia, similar to the magnesia compounds lately described by Souchay and Leussen.

REVIEWS.

Canada at the Universal Exhibition of 1855.—Printed by order of the Legislative Assembly. Toronto : John Lovell, 1856.

The success which attended the Canadian exhibition at London, in 1851, naturally led to the expectation that no efforts would be spared to present at Paris, in 1855, a correct representation of the Natural Productions and Industry of this vast Province.

It was a triumph of no common order to receive a public acknowledgement of "the superiority of the Canadian collection at London, as far as the mineral kingdom was concerned, to all countries that forwarded their products to the Exhibition," and the "very remarkable specimens of the chief varieties of Canadian timber," together "with the fine supply of wheats, every sample of more than average excellence," so favorably noticed by the jurors, inspired the hope that Canada would be fairly represented and appreciated at the great Paris Exhibition, in 1855. Nor has this hope been disappointed, when the vast distance which separated us from the scene of rivalry and display is considered, and the facilities which wealth, leisure, and position, conferred on the majority of European Exhibitors.

With few exceptions, it could scarcely be a subject of personal pecuniary interest to the farmers and manufacturers of this country to send the results of their industry or skill to compete with ages of experience in Europe. Even the products of our forests, though if known in all their variety and excellence beyond our borders, they would doubtless create a profitable market, yet, if their representation had been altogether left to the unremunerated zeal of private contributors, it is scarcely probable that even they would have been fairly represented. Hence the Provincial Committee, appointed to secure a fitting representation of the products of this Country at the Paris Exhibition, arrived at the conclusion, that any attempt to induce *voluntary* efforts by local fairs, such as those which were held at Toronto and Montreal previous to the Exhibition of 1851, would be fruitless, and that it would be absolutely necessary that the Provincial Committee should have the authority to purchase such articles as they deemed it expedient to transmit to Paris.

In accordance with this suggestion the Canadian Government appropriated a sufficient sum to cover all the expenses of the transit and ultimate purchase of the articles sent. It was further suggested by the Executive Committee that every effort should be made to secure a satisfactory representation of the great staple products of Canada—Minerals, Agricultural Products, and Timber—so successfully represented at London in 1851; and also, that the manufactures of the country should be exhibited in their progressive stages up to the highest point of perfection. Local exhibitions were held at Toronto and Montreal, and selections made as in 1851, for transmission to Paris. Hence it appears that no effort was spared to have Canada properly represented, and with what success we are informed by Mr. Taché's Report of "Canada at the Universal Exhibition of 1855."

We are told that the display of the products of Mines, Forests, and Agriculture "was truly magnificent," and that the premiums obtained were such as to give full satisfaction to all who were interested in exhibiting the natural resources of Canada to the greatest advantage. The samples of agricultural product were very fine, and included every variety of the cereals cultivated in this country. Fifty-six different kinds of minerals are enumerated in the catalogue of articles sent, and sixty-four kinds of woods, together with numerous models in wax of the vegetables and fruits grown in the Province. The Executive Council close their report, which forms the first part of Mr. Taché's volume, "with the consoling reflection that the most complete success has crowned the undertaking, for the due carrying out of which, the country has manifested such earnest solicitude."

The two special Commissioners, Sir W. Logan and Mr. Taché, divided the duties of their office, the former undertaking the arrangement of the exhibition; the latter, the diffusion of information respecting Canada throughout Europe, and of the entire exhibition throughout Canada. These efforts resulted in attracting a larger share of public attention to Canada, in proportion to its population, than to any other country; and, Count Jaubert, in his work entitled "La Botanique à l'exposition universelle de 1855," reproachfully says, "now we can form an estimate of the value of those few arpents of snow ceded to England with such culpable carelessness by the Government of Louis XV."

The testimony of many distinguished men may be adduced to shew that the most complete success crowned the efforts made by this country at the Universal Exhibition, and in one history of that wonderful pageant, Mr. Robin, the author, remarks: "the efforts made by Canada, that old French Colony, to make a suitable appearance at the great Exhibition of 1855, efforts which have resulted, moreover, in the most complete success, coupled with the undoubted importance of that fine country, whose future cannot be otherwise than brilliant, render it a duty on our part to devote to it a distinct chapter." Canada obtained one grand medal of honour (Sir W. Logan,) and is the only colony which secured that distinction—one medal of honour for the collection of woods and grains, thirteen silver medals, thirty bronze medals, and forty-eight 'honorable mentions,'—making altogether ninety-three prizes carried off at Paris, while at London the number of prizes awarded to this country amounted only to sixty-three. Mr. Romain's Steam Cultivator was not exhibited, it having been purchased and withdrawn from the exhibition by the celebrated

Agricultural Machine makers, Crosskill & Co., and is now designated as "Romain's Canadian Steam Cultivator."

Mr. Taché published in Paris his prize essay entitled "Esquisse sur la Canada consideré sous le point de vue économiste,"—and in the report before us a translation of this little work is given. He also published a descriptive catalogue of the productions of Canada, exhibited in Paris in 1855, and at the end of each enumeration of articles embraced in the different classes, he gives their prices in this country, and appends remarks as to their distribution, commercial importance, &c. With reference to our progress in mining industry, we find that the exportations of metals from our mines was valued at £8,350 in 1852, and £74,000 in 1854. Attention is directed to the value of the Tamarack, as a serviceable wood, rapidly growing into favour in Europe. The oil of the black porpoise, *Delphinus minor*, is particularly noticed, on account of its remarkable property of retaining its fluidity at a very low temperature. Porpoise leather is altogether an article of Canadian manufacture, and possesses many valuable peculiarities. Birds'-eye maple was found to be excluded from general use in the Paris cabinet manufactories, on account of its price, and Mr. Taché very appropriately mentions the fact that it is used for fuel in Canada, and ought to be supplied at a price little above that of the commonest woods.

We are next furnished with "Observations on the Exhibition," which have already been published in the form of correspondence, addressed, during the exhibition, to a portion of the French Press of Lower Canada; these are republished in the Report, by order of the House of Assembly. Among many facts of interest to Canadians, contained in these instructive and attractive letters, we are told that the total area of the Crystal Palace at London, in 1851, was about 800,000 square feet—that of the Palace of Industry and its Annexe at Paris, exclusive of the Palace used for the exhibition of Fine Arts, 1,200,000 feet. The number of exhibitors at London was 14,840, at Paris 20,839.

Bearing in mind the depopulated condition of many of our Canadian rivers, which once swarmed with fish, Mr. Taché notices the illustrations of the new art of Pisciculture, and the specimens of young fry and spawn exhibited by Mr. Mallet, "who rears pike, carp, eels, &c., as other people do puppies." Various plans of fish-ways up mill dams are eminently suggestive, and ought to be introduced on every Canadian river where a dam is constructed, tending to oppose the upward progress of the fish in spawning time, and thus to depopulate our rivers.

Mr. Letailleur's success in replacing rare furs by sheep skins prepared and dyed in various ways and colours, appears likely to commend itself to Canadian manufacturers.

Comparing the Canadian part of the Exhibition with its European rivals, Mr. Taché says :

"In the first class, embracing all that relates to the extraction of mineral substances, and to the minerals themselves, we were among the last, and far behind most countries, in regard to metallurgical operations, for the very simple reason that we are deficient in the population and capital which carry on, and still more deficient in the men of science, who in France, England, Austria, Prussia, Belgium, and other countries, direct and enlighten the labors of the mine. But if we proceed to an examination of the minerals in their natural state, our section at once assumed the first rank, and no country was in a condition to compete with us for a moment, either in the aggregate or the details of the department. The class of Canadian minerals was the most complete, and had the advantage of displaying at a glance to the learned observer the geological configuration of the country, with reference to the industrial results which it may yield. For this success, which is a mere repetition of that obtained at London in 1851, Canada is indebted entirely to the geological commissioners; and this shews to demonstration, the necessity of continuing the labors of that commission on a more liberal scale. We possess in the bosom of the earth the untouched riches, which in England have been the main element of industrial and commercial greatness; but the conditions of progress towards that greatness, are the light of science, and extensive enterprise. Mining operations cannot be profitably conducted on a small scale.

When we reflect that the iron which abounds in Canada is nearly of the same quality as that of Sweden, that it is found in places, surrounded by immense forests, and that, we have at hand the stone, sand, and other matters which are necessary for the smelting, moulding, and casting of the metal, we may well wonder that every year we import from England, Sweden, and the United States, manufactured iron to the amount of more than £1,000,000. But, we must again observe, success attends such enterprises, only when undertaken on a grand scale, whatever the abundance of the raw material. The working of an iron mine is not for limited means, nor to be carried on on a petty scale. A cheap market must be a full market. In Europe blast furnaces are now built, capable of smelting 80,000 lbs. per diem. The want of coke in Canada, be it observed, does not oppose an obstacle to the successful prosecution of iron-works. Ours is a country of rich forests 270,000 square miles in extent. Sweden smelts her iron with charcoal only, and sells it to England for a paying price; the English convert it into steel and send it to other countries. Other European countries use charcoal, notwithstanding the general scarcity and dearness of wood in Europe."

It appears also that "no country could compete with us in the show of woods, and particularly of the kinds used in ship-building, including in the estimate all the various species. In this class are embraced, moreover, all the products of the chase and the fisheries, in which departments the Gulf, and the vast territories of the Saguenay and the North-West, place us beyond competition, if not as producers,

at least as proprietors of the finest field for production, in the whole world." The hints derived from an inspection of the raw material used by cabinet makers and carpenters among European nations, suggest very extensive alterations in the mode of getting out timber in our Canadian Forests, which deserve special notice.

"In lumbering, as the making of timber is termed in Canada, just that amount of intelligence is brought into action, which is required for the squaring of the logs, and the sawing of them into the planks of commerce. None of that skill of woodcraft is exercised which turns to the best and most profitable account the various species, by attending to their several degrees of adaptation to the mechanic arts, and to the preparation to be expended on them to make them fit for market. As before observed, two things only are known, square timber and the plank three inches thick. A more recondite study of the application of timber to the mechanic arts, would instruct us in the fact, that there are conditions of length, girth, and diameter required in those arts, by the influence of which the square log of 50 feet long by 20 inches square, and plank of 12 feet by 10 inches, lose their intrinsic value as compared with that higher value which is derivable from compliance with those conditions. How many are the trees left to rot in the forest because they are not reducible to a saw log of the standard measure, or a square stick of the required dimensions: which, trimmed to another form, would in other markets bear a greater value, though diminished in volume.

Of more than sixty principal species of timber which we possess, we make profitable use of scarcely ten, the rest are left to absolute decay. In Europe the birds'-eye maple is considered as equal to the most precious of the woods used in cabinet-work. It is indeed hardly attainable, and when found, it bears a higher price than mahogany. From this cause arises the dearness of all the articles made of maple in Parisian cabinet-work, the finest in the world."

Our agricultural productions when compared with those of other countries placed us on a level with the foremost: "our grain won the admiration of all who saw it." The absence of Hemp, Flax and Tobacco, however, was particularly noticed in the Canadian section, and our climate and soil were thought to furnish very favourable conditions for the cultivation of those valuable articles. It is not perhaps generally known by those who expressed surprise at the absence of Tobacco, that the late spring frosts to which our climate is subject, render the growth of Tobacco an expensive and very hazardous experiment. Where labour is very dear and sowing time very transient, it becomes a mere matter of calculation how far the growth of Tobacco may be made remunerative. It has often succeeded admirably in the western peninsula, but the occurrence of late frosts has not unfrequently destroyed the crops over wide areas and discouraged the cultivation of this important narcotic. Hemp and Flax give better promise of remunerative returns, and will no doubt soon form an important article of Canadian production.

Our castings did not meet with much favour, and the reasons may be drawn from the following observations by Mr. Taché :

"What lightness is found in the railings, the iron seats, &c., of the English manufacture of the Coalbrookdale Company in Shropshire, and how cheap also are the articles? The reason is plain, the purchaser has not to pay for a lot of useless iron."

"What elegance there is in the stoves and other articles of French manufacture, from the blast furnaces of the Marquis de Vogué of France? These designs of hunting and historical scenes are bas-reliefs of art, and the articles are not dearer on that account, because the material is not wasted; and as to the casting, the beautiful costs no more than the most deformed piece that ever was moulded. This is now generally understood; and in England where art is less perfect than in France and Belgium, the proprietors of foundries endeavour to procure artists from those two countries. A French sculptor, M. Geneste, is at this moment, in the receipt of a salary of £2000 per annum from an English manufacturer."

"The art of combining the useful with the agreeable is the climax of material progress. The study of the beautiful in art, is, to the intellectual man, what the study of truth is to his moral existence."

From many admirable inventions and applications which commend themselves to the attention of Canadians, and which are specially noticed with that object by Mr. Taché, we select some which appear likely to meet with adoption and favour. A smoke consuming coal grate, which is in the shape of an endless chain, and uncoils as the coal is consumed, thus combining advantages of health and economy. A machine by M. Chevalier, which by means of an endless steel wire adapted to pullies, saws with the greatest regularity the hardest stone, as quartz, granite, and even crystal. Two machines by M. Sautreuil, of Léchamp; one for preparing flooring boards by a single stroke, the other a planing machine, for smoothing timber for building purposes, on four sides at once. Messrs. Irey and Roly, of Paris, have introduced caoutchouc as a material for springs in all their machines. In the manufacture of chemical matches, for the production of an instantaneous light, Austria employs not less than 20,000 persons, and the highest price for round matches is only one penny per thousand. Mr. Quinti, of Vienna, showed how by interrupting the current by non-conductors, two communications may be transmitted simultaneously in opposite directions by the same wire. The preservation of food by the perfect exclusion of external air is easily accomplished by the immersion of game, or other meats, in a warm solution of gelatine. The celebrated Russia Leather is tanned with the decoction of willow bark, and impregnated with an oil extracted from the bark of the bouleau. A curious result of the artificial preparation of a valuable pigment is shown in the manufacture of Ultramarine. The nat-

tural mineral used to cost £75 per pound, and no more than four pounds were used in Europe in a year; now Europe manufactures and consumes 5,000,000 lbs. per annum, at a cost of one shilling per pound. One of the active principles in opium having been artificially produced there is no doubt but that quinine and other valuable medicinal agents will be prepared on a large and cheap scale in the laboratory. Vegetables may be prepared, for keeping by exposure to hot air and powerful compression, so that 1200 lbs. of dried vegetables may be packed into a space little exceeding a cube yard; but 1200 lbs. of dried vegetables represent 8000 lbs. in their natural condition, which would require nearly forty cubic yards to contain them. The allied armies in the Crimea were provided with vegetables thus prepared to the extent of 42,000,000 rations. M. Coignet, of St Denis, exhibited a stone consisting of coal ashes and quick lime; or of sand, small shingle and lime: it is run like grouting. We may here observe that this method of building has long been practised in Amerca and even in the neighbourhood of Toronto.

It is unnecessary to advert to the "Sketch of the Geology of Canada," by Sir W. Logan and Mr. Hunt, or to the beautiful geological map accompanying the sketch, which are together appended to Mr. Taché's report, as these admirable and instructive illustrations of our mineral wealth have already been noticed in the Canadian Journal (new series, vol. i, p. 379.) We shall draw this brief summary of Mr. Taché's report to a close with a quotation from M. Fresca's work on the Exhibition; deeming it more satisfactory to receive and accept the testimony of a distinguished foreigner, than to express the favourable opinions of our great success at Paris which the perusal of Mr. Taché's report create.

"Canada," says M. Fresca, "is a land of hope not likely to be disapointed. Active, intelligent, and enterprising beyond all other nations, which equally abound in the elements of industral production, she claims and demands our attention."

H. Y. H.

The Tenth Annual Report of the Smithsonian Institution for the year 1855. Washington, 1856.

To such of our readers as are unacquainted with the origin and operation of this splendid establishment, the following brief notice may not be unacceptable:

Hugh Smithson, from whom the institution derives its name, was a relative of the Duke of Northumberland. He was much devoted to physical science, and at Oxford, where he graduated, enjoyed the reputation of being the best chemist in the university. He was a cosmopolitan in his views, and used to express himself to the effect that the man of science belongs exclusively to no country; that the world is his country and all men are his countrymen. It was, it is believed, at one time his intention to leave his property to the Royal Society of London, for the promotion of science, but in consequence of a misunderstanding with the council of the society, he changed his mind and left it to his nephew, and, in case of the death of that relation without issue, to the United States of America, to found the institution which now bears his name.

In 1829 Smithson died, leaving his fortune, £120,000, in case of the death of his nephew, to whom it was first bequeathed, to found at Washington, under the name of the Smithsonian Institution, an establishment for the *increase* and *diffusion* of knowledge among men.

In 1838, the nephew having died, the money was paid over by the English Court of Chancery to the Agent appointed by the Government of the United States; and eight years afterwards, in 1846, an Act was passed through Congress for the establishment of the Smithsonian Institution.

By this Act the immediate government of the institution devolved upon the Board of Regents consisting of the following 15 members:

The Vice-President of the United States, the Chief Justice of the Supreme Court, the Mayor of the City of Washington, ex-officio; three members of the Senate, to be appointed by the President thereof; three members of the House of Representatives, appointed by the Speaker; six persons chosen from the citizens at large by joint resolution of the Senate and House, two of whom shall be members of the National Institute, and the other four inhabitants of states, and no two from the same state.

With a view of carrying the wishes of the testator into effect the Secretary, Professor Henry, was empowered to draw up a programme for the organization of the institution, which was presented in his first Annual Report to the Board of Regents and adopted by them in 1847.

As this programme is presented in the report before us we are enabled to give some extracts which serve to exhibit the principles

that guide the governing body, as well as the mode of carrying the objects of the institution into effect.

"General considerations which should serve as a guide in adopting a plan of organization.

(1). Will of Smithson. The property is bequeathed to the United States of America to found at Washington, under the name of the SMITHSONIAN INSTITUTION, an establishment for the increase and diffusion of knowledge among men.

(2). The bequest is for the benefit of mankind. The Government of the United States is merely a trustee to carry out the design of the testator.

(3). The institution is not a national establishment, as is frequently supposed, but the establishment of an individual, and is to bear and perpetuate his name.

(4). The objects of this institution are, 1st., to increase, and 2nd, to diffuse, knowledge among men.

(5). These two objects should not be confounded with one another. The first is to enlarge the existing stock of knowledge by the addition of new truths; and the second, to disseminate knowledge, thus increased, among men.

(6). The will makes no restriction in favor of any particular kind of knowledge; hence all branches are entitled to a share of attention.

(13). It should be recollected that mankind in general are to be benefited by the bequest, and that, therefore, all unnecessary expenditure on local objects would be a perversion of the trust.

(14). Besides the forgoing considerations, deduced immediately from the will of Smithson, regard must be had to certain requirements of the Act of Congress establishing the institution. These are, a library, a museum, and a gallery of art, with a building on a liberal scale to contain them."

In order to carry out the two leading objects of the will of Mr. Smithson, the *increase*, namely, and the *diffusion* of knowledge, the same report recommends the following plans:

To *increase* knowledge one means proposed is to stimulate men of talent to make original researches by offering suitable rewards for memoirs containing new truths. The memoirs thus obtained are to be published in a series of volumes, and entitled Smithsonian Contributions to Knowledge.

Among the various objects of research named for which pecuniary appropriations may be made are included, a system of meteorological observations for solving the problem of American storms; Explorations in Natural History and Geology; Magnetic and Topographical Surveys; the solution of various experimental problems; and Statistical, Historical and Ethnological enquiries.

To promote the *diffusion* of knowledge the two leading means suggested are the publication of periodical reports on the progress of different branches of knowledge, and the publication occasionally of separate treatises.

For the preparation of these reports it is proposed that men

eminent in the respective branches be employed, that they be furnished with journals and other necessary publications, and that they be paid a certain sum for their labors.

In virtue of the Act of Congress, the Secretary and his assistants, during the session of Congress, will be required to illustrate new discoveries in science and to exhibit new objects of art; distinguished individuals will also be invited to give lectures on subjects of general interest.

On the occasion of the meeting of the Regents in 1847, it was resolved to divide the income into two equal parts; one to be appropriated to increase and diffuse knowledge agreeably to the scheme above given; and the other part to be appropriated to the formation of a library and a collection of objects of nature and of art.

This resolution was, however, rescinded at the meeting of January, 1855, when it was determined that

"The annual appropriations should be apportioned specially among the different objects and operations of the institution, in such manner as might, in the judgment of the Regents, be necessary and proper for each, according to its intrinsic importance, and a compliance in good faith with the law."

Admirably adapted as the foregoing scheme would seem to be for carrying out *boná fide*, the design of the founder, efforts have been made by some persons to divert from their legitimate channel the funds destined for cosmopolitan purposes, and to expend them on objects of a comparatively local character. The good sense and honorable feeling of the nation have, however, triumphed, and will, it is hoped, insure the permanence of the institution on its present footing. The mode of procedure adopted by the Regents in conducting the affairs of the institution having been brought under the notice of Congress in 1855, the matter was referred to a Special Committee of the House of Representatives and to the Judiciary Committee of the Senate. In reporting subsequently on the matter the Judiciary Committee unanimously approved of the acts of the Regents in construing the law of Congress, in interpreting the will of Smithson, and in what they had done in the way of increasing and diffusing knowledge among men.

In the verdict of the Judiciary Committee we find the following language:

(Referring to the legacy). "It is not bequeathed to the United States to be used for their own benefit and advantage only, but in trust to apply to the increase and diffusion of knowledge among mankind generally, so that other men and other nations might share in its advantages as well as ourselves."

Again, in reference to the proposed application of the funds to the formation of a library, the Judiciary Committee go on to say:

"Such an application of the funds could hardly be regarded as a faithful execution of the trust; for the collection of an immense library at Washington would certainly not tend to increase or diffuse knowledge in any other country, not even among the countrymen of the testator; very few even of the citizens of the United States would receive any benefit from it.

"This is the construction which the Regents have given to the Acts of Congress, and in the opinion of the committee, it is the true one, and, acting under it, they have erected a commodious building, given their attention to all the branches of science mentioned in the law, to the full extent of the means afforded by the fund of the institution, and have been forming a library of choice and valuable books, amounting already to more than fifteen thousand volumes. The books are, for the most part, precisely of the character calculated to carry out the intentions of the donor of the fund, and of the Act of Congress. They are chiefly composed of works published by or under the auspices of the numerous institutions of Europe which are engaged in scientific pursuits, giving an account of their respective researches and of new discoveries whenever they are made. These works are sent to the Smithsonian Institution in return for the publications of this institution which are transmitted to the learned societies and establishments abroad. The library thus formed, and the means by which it is accomplished, are peculiarly calculated to attain the objects for which the munificent legacy was given in trust to the United States. The publication of the results of scientific researches made by the institution is calculated to stimulate American genius, and at the same time enable it to bring before the public the fruits of its labors. And the transmission of these publications to the learned societies in Europe, and receiving in return the fruits of similar researches made by them, gives to each the benefit of the increase of knowledge which either may obtain, and at the same time diffuses it throughout the civilized world. The library thus formed will contain books suitable to the present state of scientific knowledge, and will keep pace with its advance; and it is certainly far superior to a vast collection of expensive works, most of which may be found in any public library, and many of which are mere objects of curiosity or amusement, and seldom, if ever, opened by any one engaged in the pursuit of science."

The Judiciary Committee conclude their report in the following terms:

"From the views entertained by the committee, after an impartial examination of the proceedings referred to, the committee have adopted the language of the resolution, 'that no action of the Senate is necessary and proper in regard to the Smithsonian Institution; *and this is the unanimous opinion of the committee.*'"

Having then briefly considered the origin, proposed objects and mode of action of this magnificent establishment, it remains for us to examine from the report for the year 1855 how far the proposed objects are in course of accomplishment.

The following are the principal contents of the report of the Regents for 1855;

The Report of the Secretary to the Board of Regents; the Report of the Assistant Secretary and Curator; Reports of sub-committees relative to expenditure; Journals of meetings of the board; outlines of several lectures delivered in the rooms of the institution; directions to meteorological observers and various reports and suggestions relative to meteorological observations; correspondence relative to Ethnological and Topographical researches; and, finally, a long and able report on the present condition of the science of galvanism, by Professor Müller, of Freiburg, and translated from the German by Mr. Baker, of the Coast Survey.

SECRETARY'S REPORT.

Among the memoirs which, in accordance with the announcement in the Secretary's Report, form the eighth volume of the Smithsonian Contributions are the following: along with others, by Major B. Alvord, and Dr. Joseph Jones; and a record of Auroral phenomena, by P. Force:

(1). On the progress of information and opinion respecting the archæology of the United States, by Samuel F. Haven, Librarian of the American Antiquarian Society.

(2). A paper on the recent secular period of the Aurora Borealis, by Professor Olmstead.

One useful function of the Smithsonian Institution is that of effecting literary and scientific exchanges between individuals and societies. The extent of their operations in this department may be judged of by the fact that in the year 1855, 8585 packages for distribution passed through the hands of the institution.

The Smithsonian agency is not confined to the transmission of works from the United States, but is extended to those of Canada and Central and South America, and its foreign relations embrace every part of the civilized world. It brings into friendly correspondence cultivators of original research the most widely separated, and emphatically realizes the idea of Smithson, that "the man of science is of no country;" that "the world is his country, and all mankind his countrymen."

The system of exchange has found favor with foreign governments, and the Smithsonian packages are now admitted into all parts to which they are sent, without detention and free of duty.

METEOROLOGY.

Since the publication of the former report an arrangement has been made with the Commissioner of Patents, by which the system of Meteorological observations established under the direction of the institution will be extended, and the results published more fully than the Smithsonian income will allow.

With respect to the complaints that have been made that but few of the materials collected have been published, the report remarks,

"It is more important that the information should be reliable than that it should be quickly published," and "what may be lost by delay is more than compensated by the precision and value of the results.

The reduction of the meteorological observations have been continued by Professor Coffin. He has completed the discussion of all the records for 1854, and those of 1855 as far as they have been sent in.

LIBRARY.

It is the present intention of the Regents to render the Smithsonian library the most extensive and perfect collection of Transactions and scientific works in this country, and this it will be enabled to accomplish by means of its exchanges, which will furnish it with all the current journals and publications of societies. The Institution has already more complete sets of transactions of learned societies than are to be found in the oldest libraries in the United States.

MUSEUM.

It is no part of the plan of the institution to form a Museum merely to gratify the curiosity of the casual visitor to the Smithsonian building, but it is the design to form complete collections in certain branches, which may serve to facilitate the study and increase the knowledge of natural history and geology.

With respect to the condition of the Museum, the report asserts that no collection of animals in the United States, nor indeed in the world, can even now pretend to rival the richness of this Museum in specimens which tend to illustrate the natural history of North America.

In the report of Professor Baird, the Assistant-Secretary, many details are given relative to the additions to the Museum. These additions have been made in great measure through the agency of the government exploring expeditions, and partly also through that of individuals under the orders of the institution.

LECTURES.

The titles of the lectures, of which the substance is given in the volume before us, are as follows:

(2). A course of lectures on Marine Algæ, by W. H. Harvey, of the University of Dublin.

(2). Natural History as applied to farming and gardening, by Rev. J. G. Morris of Baltimore.

(3). Insect instincts and transformations, by the same.

(4). On oxygen and its combinations, by Professor Chase, of Brown University

(5). On meteoric stones, by Lawrence Smith, of the University of Louisville, Ky

(6). On planetary disturbances, by Professor Snell, of Amherst College.

The first lecture, by the Rev. Mr. Morris, on natural history as applied to farming and gardening, will be read with peculiar interest at the present time, when attention has been so much attracted to insect ravages on the corn crops. One practical evil, spoken of by the lecturer, arising from ignorance of the habits of insects, is that farmers and gardeners, by destroying one class of noxious animals,

expose themselves to the ravages of more numerous and destructive creatures, whose numbers, the first, if suffered to live, would have kept within bounds. Speaking of one kind of moth, peculiarly hurtful to the vineyards in France, and of what may be done to check the evil if the habits of the creature be understood, he states that in twelve days from twenty to thirty women and children destroyed upwards of forty millions of eggs that would have been hatched in a few days. From the sketch of this lecture given, we are led greatly to regret that the abstract should not have had a greater space allotted to it than five pages.

LECTURE ON METEORIC STONES, BY DR. J. L. SMITH.

The lecturer distinctly maintains the lunar organ of meteoric stones. The discussion which, even in its abridged form, occupies twenty-four pages, is concluded in the following terms:

"To sum up the theory of the lunar origin of meteorites, it may be stated that "the moon is the only large body in space of which we have any knowledge, "possessing the requisite conditions demanded by the physical and chemical pro-"perties of meteorites; and that they have been thrown off by volcanic action, "(doubtless long since extinct) or some other disruptive force, and encountering "no gaseous medium of residence, reached such a distance as that the moon ex-"ercised no longer a preponderating attraction, the detached fragment possessing "an orbital motion and an orbital velocity, which it had in common with all parts of "the moon, but now more or less modified by the projectile force and new condi-"tion of attraction in which it was placed with reference to the earth, acquired "an independent orbit more or less elliptical. This orbit, necessarily subject to "great disturbing influences may sooner or later cross our atmosphere and be "intercepted by the body of the globe."

The lecture of Professor Snell is an able popular exposition of the subject of planetary disturbances.

METEOROLOGY.

Of the matter contained in the present volume, that of the greatest importance on account of its immediate connection with a great scientific movement now in progress in Canada, is the body of directions for the meteorological observations adopted by the Smithsonian Institution. These instructions are well worthy of the study of all persons interested in this class of research.

Following the directions to observers is an account of a series of observations carried on, chiefly for the purpose of ascertaining the duration of thunder claps.

The Report of Professor Müller on galvanism, extending as it does through upwards of 100 closely printed pages, puts any attempt at analysis in our limited space utterly out of the question; we can

only, therefore, refer our readers, for more ample details, to the pages of the work.

In laying down for the present the report of the Smithsonian Institution, (and it is with no little regret that we lay it down,) we derive our chief consolation from the recollection that it is not a solitary work, but one of a series, and that we may look forward to a renewal on each succeeding year of the enjoyment we have found in the perusal of the volume that we have just closed.

G. T. K.

SCIENTIFIC AND LITERARY NOTES.

GEOLOGY AND MINERALOGY.

FOSSILS FROM ANTICOSTI.

During a recent visit to the Museum of the Geological Survey in Montreal, we were much gratified by the inspection of a fine collection of fossils, just received by Sir William Logan, from the Island of Anticosti. The greatest praise is due to Mr. Richardson, by whom, in the short space of a few months, this really magnificent collection was obtained. A preliminary examination by Professor Hall, of Albany, and Mr. Billings, the palæontologist attached to the Survey, has shewn the existence of a great number of new Brachiopods and other types—some, indeed, of a character at present altogether problematical. Amongst other facts of interest brought to light by the collection, we may mention the simultaneous occurrence in one of the Anticosti beds, of many well-marked forms belonging to both the Lower and Upper divisions of the Silurian series: a phenomenon not hitherto observed, or at least to a similar extent, in American rocks—the line of demarcation between the Upper and Lower Silurians of the Western World, being, as a general rule, very strongly pronounced. The lowest of the observed beds in Anticosti itself, belongs to the Hudson River Group; but the Sillery formation (the next in an ascending order) so largely developed along the Southern shores of the St. Lawrence, appears to be entirely wanting. Geologists may look forward with much interest, to the results of Professor Hall's detailed examination of this important addition to our knowledge of Palæozoic forms.

ASAPHUS LATIMARGINATUS.

[*A. Canadensis*—E. J. C.]

In the *Canadian Journal* for September of last year (vol. 1, p. 482), we called attention, under the name of *Asaphus Canadensis*, to a new form of Trilobite, from Whitby, in Canada West. Quite recently, we have received a letter from Professor Hall, in which that able palæontologist suggests to us that the Trilobite in question is probably his *Asaphus latimarginatus*. Professor Hall states that the

Museum of the Geological Survey of Canada has lately received some very perfect specimens of that species from the neighbourhood of Whitby; and he kindly promises us a drawing and revised description of his original species, for an ensuing number of the Journal. The only figures of *Asaphus latimarginatus* that we have had an opportunity of examining, consist merely of two more or less imperfect caudal shields given in the first volume of Hall's Palæontology of New York. Neither thorax nor buckler has, we believe, been hitherto figured or described—at least beyond the brief description given in our note in the number of the *Canadian Journal* already alluded to. If the two forms prove to be identical, the original name of *A. latimarginatus*, as applied by Prof. Hall to the species founded on the two imperfect caudal shields figured by him in his Palæontology, must, of course, take the place of *A. Canadensis*, notwithstanding the appropriateness of the latter. Up to the present time, indeed, it is only in Canada that anything like complete specimens have been met with. The following is a description of the form to which our original remarks applied:

Cephalic shield pointed anteriorly, and in its general outline closely resembling that of *Asaphus platycephalus**, but with the posterior angles terminating in horns† which extend downwards to the bottom of the fourth thoracic segment. Facial sutures united in front at the extreme anterior margin of the buckler, and terminating as in *A. platycephalus* about midway between the glabella and the angles of the head-shield. Glabella very feebly raised; broad, and somewhat squared above; but without furrows of any kind. Eyes apparently as in *A. platycephalus*, but much destroyed in all the specimens examined. For dimensions, see below.

Thorax with eight segments. Pleuræ somewhat sabre-shaped (the curve upwards‡); grooved to about half their length from the axis outwards, and then crossed obliquely by a curvilinear ridge: the points of the pleuræ beyond the ridge, delicately striated.

Caudal shield with well developed axis: the axis tapering, and terminating rather abruptly before reaching the extremity of the pygidium; number of the rings not observable in the specimens examined.§ Pleuræ 14 in number, without grooves or ridges; bent downwards abruptly near the striated margin into which they merge. The lower ones, almost vertical.

Whole surface of the trilobite finely punctured, except at the striated limb. The punctures on the pleuræ, larger and farther apart than those on the axis. Also of a crescented or semi-circular form, with the convex and more deeply indented side turned inwards.

Relative (approximate) dimensions:—Assumed length of Buckler =1. Glabella, length =·812. Thorax, length =·875. Pygidium, length =1·06. Middle lobe of Thorax, breadth =·50 to ·60. Outer lobes (each), breadth =·70. The small breadth of the middle lobe in relation to the side lobes, as compared with *Asaphus platycephalus*, appears to be of some importance, unless it be a mere sexual

* *Isotelus gigas*, Auct.

† This part of the head-shield is very obscure in the specimens hitherto examined. We were led at first to believe that the angles were rounded.

‡ This, however, is only to be seen when the pleuræ have become accidentally separated to a certain extent from one another.

§ Since the above description was written, the son of His Excellency the Governor General, has kindly submitted to us some specimens obtained by him personally from the Whitby quarries. In one of these, the pygidium of a young individual, fourteen rings may be counted in the axis.

difference. Where, however, the pleuræ are bent, the length of the side lobes can rarely be estimated with any great exactness.

The average adult size of these trilobites appears to be about 4½ inches in length, by about 3 inches in breadth; but, judging from isolated fragments, larger individuals no doubt occur. Many of the Whitby specimens, at the same time, are much below the above dimensions. Most of them are converted into iron pyrites. The *Asaphus Barrandi* of Hall appears to be a closely related species.

FOSSILS FROM ALTERED ROCKS IN EASTERN MASSACHUSETTS.

A very interesting discovery of a trilobite—a species of Paradoxides—in the metamorphic rocks of Quincy and Baintree, about ten miles South of Boston, has just been announced to the scientific world, by Professor W. B. Rogers. The true place of these rocks, hitherto of uncertain paleozoic range, would thus appear to belong to quite the base of the Silurian series: at least if the trilobite in question be really a paradoxides—in which case, it will also be of interest, as constituting the first true species of that genus met with in American rocks since the announcement of Green's debatable *Paradoxides Harlani* in 1832. Full particulars of this discovery will be found in the last October number of the Edinburgh New Philosophical Journal; and in the Proceedings of the Natural History Society of Boston, for the same month.

BURR-STONE.

A curious deposit of Burr-stone, constituting a vein of considerable thickness, has lately been discovered by Sir William Logan, in the gneiss of Chatham, in Canada East. The stone, probably a siliceous deposit from heated waters, occurs, according to Sir William, in close association with several complicated veins of igneous rock of at least three different periods of formation. As the stone is of excellent quality, and readily obtainable, the discovery—apart from the scientific interest belonging to the mode of occurrence of the deposit—is one of no little importance. Specimens may be seen in the Museum of the Geological Survey at Montreal.

RED OXIDE OF COPPER.

Mr. James Gilbert, lately returned from California, has presented to the Institute, some specimens of red copper ore from the Arizona mines, 110 miles S. E. of Fort Yuma, and about 35 miles from the River Gila. As samples, the specimens are extremely rich, being almost free from rock matter. They contain small strings of native copper, from which the Cu^2O has evidently been derived; and by a further process of alteration, the ore is converted externally, into malachite. The occurrence of red copper in California has not hitherto been announced in any of our treatises on Mineralogy. We are ignorant of its geological associations.

VANADINITE.

In the last number of the *Journal*, (vol. 1, page 553), an analysis, by Rammelsberg, of Vanadinite from Windisch-Kappel, was given; the results of which lead to the inference that VO^3 and PO^5 are isomorphous. Adolf Kengott, (in Poggendorff's Annalen, 1856, No. 9), has subjected this analysis to a very elaborate discussion, in which he seeks to maintain that the loss of 3.21 per cent. therein exhibited, must be due to some cause other than accidental. To account for this loss, he assumes the original existence in the mineral of the hypothetical com-

pound VO^5. Rammelsberg's analysis gave 17.41 per cent. of VO^3: a value corresponding to 20.31 per cent. of VO^5. In this manner the total results of the analysis are brought up to 99.69; and the isomorphism of Vanadinite with Pyromorphite satisfactorily explained. Before this view can be received, however, it will be for the chemist to determine if there be any real grounds for the assumption of the existence of this higher oxygen compound. So far as present researches go, the tendency of vanadic acid, VO^3, would appear to be altogether towards reduction. The question, however, here, is not the conversion of VO^3 into VO^5, but the reverse: a process which we might readily conceive to take place, were the existence of the latter compound allowed to be probable.

E. J. C.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

CHELTENHAM, 6th August, 1856.

After the requisite preliminary business, conducted by the General Committee of the Association, and including the reading of the Report of the Council, and of that of the Kew Committee, the body of members assembled to witness the resignation of the Chair by the Duke of Argyle, to his successor, Professor Daubeny, and to hear the President's Address. On this occasion the occupation of the Chair of the British Association by one not only distinguished as a Chemist, but by one who is no less eminent as a Botanist, gave a new character to the Presidential Address. After some preliminary remarks of a personal nature, Dr. Daubeny proceeded with his address, from which we have only room for a brief selection of passages of special interest. Referring to the British Association as alike valuable as an efficient instrument for the furtherance of scientific objects, and as a model after which other associated scientific bodies have been organized, the President thus proceeded:

It is rather remarkable that the first idea of an Association of such a kind should have suggested itself only a year after death had deprived us of our three most distinguished philosophers:—for who had we then left to compare with Davy for the brilliancy and importance of his discoveries; with Young for the singular union of almost universal acquirements with admirable powers of invention; and with Wollaston for an acuteness of mental vision, which gave him the same advantage in the pursuits of science which the naturalist, armed with a microscope has over the unassisted observer? Just as in the animal economy the *vis medicatrix naturæ* sometimes makes an extraordinary effort to repair the damage inflicted by injury or disease, so it would seem as if Science, conscious of the loss she had sustained in the almost simultaneous extinction of her three brightest luminaries, endeavoured to make good the deficiency by concentrating into one *focus* those that yet remained, to light her onwards on her path. At any rate, the progress which the Natural Sciences have made since that period, although doubtless attributable to several concurrent causes, is a fact which must not be overlooked in estimating the services rendered by this Association to the cause of human advancement; nor can I in any better manner point out its value than by bringing before your notice a few of the additions to our knowledge which have been made since I last addressed you.

Beginning then with Chemistry, as the subject with which I am most familiar, let me remind you, that at a period not much more remote than the one alluded to, all of it that could be quoted as really worthy the name of a science was comprehended within the limits of the mineral kingdom. Here at least the outline had been traced out with sufficient precision—the general laws established on a firm basis—the nomenclature framed with logical exactness—the facts consistent with each other, and presented in a scientific and luminous form. Thus a philosopher, like Sir Humphrey Davy, who had contributed in so eminent a degree to bring the science into this satisfactory condition, might, at the close of his career, have despaired of adding anything worthy of his name to the domain of chemistry, and have sighed for other worlds to subdue. But there was a world almost as little known to the chemists of that period as was the Western Hemisphere to the Macedonian Conqueror,—a World comprising an infinite variety of important products, called into existence by the mysterious operation of the vital principle, and therefore placed, as was imagined, almost beyond the reach of experimental research. This is the new World of Chemistry, which the Continental philosophers in the first instance, and subsequently those of our own country, have during the last twenty years been busy in exploring, and by so doing have not only bridged over the Gulf which had before separated by an impassable barrier the kingdoms of inorganic and of organic nature, but also have added provinces as extensive and as fertile as those we were in possession of before, to the partrimony of Science.

It is indeed singular, that whilst the supposed elements of mineral bodies are very numerous, the combinations between them should be comparatively few; whereas amongst those of vegetable and animal origin, where the ultimate elements are so limited in point of number, the combinations which they form appear almost infinite. Carbon and hydrogen, for instance, constitute, as it were, the keystone of every organic fabric; whilst oxygen, nitrogen, and less frequently sulphur and phosphorus, serve almost alone to build up their superstructure. And yet what an infinity of products is brought about by ringing the changes upon this scanty alphabet! Even one series of bodies alone, that known by the name of the Fatty Acids, comprises several hundred well-ascertained combinations, founded however upon a single class of hydro-carbons or compound radicals, in which the carbon and hydrogen stand to each other in equal atomic proportions, and are in each case acidified by the same number of equivalents of oxygen. These acids are all monobasic, or combine with only one proportion of base; but add to any one of them two equivalents of carbonic acid, and you obtain a member of a second series, which is bibasic, or is capable of forming two classes of salts. The above therefore constitute a double series, as it were, of organic acids, the members of which are mutually related in the manner pointed out, and differ from each other in their mode of combining according to the relation between their respective elements. But already, by the labours of Hofmann and of other chemists, two other double series of acids, the one monobasic, the other bibasic, mutually related exactly in the same manner as those above, have been brought to light; each series no doubt characterized by an equally numerous appendage of alcohols, of æthers, and of aldehydes, to say nothing of the secondary compounds resulting from the union of each of these bodies with others.

Hence the more insight we obtain into the chemistry of organic substances the more we become bewildered with their complexity, and in investigating these phe-

nomena, find ourselves in the condition of the explorer of a new continent, who, although he might see the same sun over his head, the same ocean rolling at his feet, the same geological structure in the rocks that were piled around him, and was thus assured that he still continued a denizen of his own planet, and subject to those physical laws to which he had been before amenable, yet at every step he took was met by some novel object, and startled with some strange and portentous production of Nature's fecundity. Even so the chemist of the present day, whilst he recognizes in the world of organic life the same general laws which prevail throughout the mineral kingdom, is nevertheless astonished and perplexed by the multiplicity of new bodies that present themselves, the wondrous changes in them resulting from slight differences in molecular arrangement, and the simple nature of the machinery by which such complicated effects are brought about. And as the New World might never have been discovered, or, at all events, would not have been brought under our subjection, without those improvements in naval architecture which had taken place prior to the age of Columbus, so the secrets of organic chemistry would have long remained unelicited, but for the facilities in the methods of analysis which were introduced by Liebig. Before his time the determination of the component elements of an organic substance was a task of so much skill as well as labour, that only the most accomplished analysts—such men, for instance, as my lamented friend Dr. Prout in this country, or as the great Berzelius in Sweden—could be depended upon for such a work; and hence the data upon which we could rely for deducing any general conclusions went on accumulating with extreme slowness. But the new methods of analysis invented by Liebig have so simplified and so faciliated the processes, that a student, after a few months' practical instruction in a laboratory, can, in many instances, arrive at results sufficiently precise to be made the basis of calculation, and thus to enable the master mind, which is capable of availing itself of the facts before it, to breathe life into these dry numerical details,—just as the sculptor, by a few finishing stokes, brings out the expression of the statue, which has been prepared for him by the laborious chiselling of a number of subordinate workmen. And as the established laws and institutions of the Old World have been modified—may I not say in some instances rectified?—by the insensible influence of those of the New, so have the principles that had been deduced from the phenomena of the mineral kingdom undergone in many instances a correction from the new discoveries made in the chemistry of the animal and vegetable creation. It was a great step indeed in the progress of the science, when Lavoisier set the example of an appeal to the balance in all our experimental researches, and the Atomic Theory of Dalton may be regarded as the necessary, although somewhat tardy, result of the greater numerical precision thus introduced. But no less important was the advance achieved, when structure and polarity were recognized as influencing the condition of matter; and when the nature of a body was felt to be determined, not only by the condition of its component elements, but also by their mutual arrangement and collocation—a principle which, first illustrated amongst the products of organic life, has since been found to extend alike to all chemical substances whatever.

Formerly it had been the rule to set down the bodies which form the constituents of the substances we analyzed, and which had never yet under our hands undergone decomposition, as elementary; but the discovery of cyanogen in the first instance, and the recognition of several other compound radicals in organic chemistry more lately, naturally suggest the idea that many of the so-called elements of

inorganic matter may likewise be compounds, differing from the organic radicals above mentioned merely in their constituents being bound together by a closer affinity. And this conjecture is confirmed by the curious numerical relations subsisting between the atomic weights of several of these supposed elements; as, for example, between chlorine, bromine and iodine: an extension of the grand generalization of Dalton, which, although it was unforeseen by the Founder of the system, and therefore, like Gay-Lussac's Theory of Volume, might very possibly have been repudiated by him, had it been proposed for his acceptance, will be regarded by others as establishing, in a manner more conclusive than before, the soundness of his antecedent deductions. What, indeed, can be a greater triumph for the theorist, than to find that a law of nature which he has had the glory of establishing by a long and painful process of induction, not only accommodates itself to all the new facts which the progress of discovery has since brought to light, but is itself the consequence of a still more general and comprehensive principle, which philosophers, even at this distance of time, are still engaged in unfolding?

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But passing over speculations which have not as yet received the general assent of chemists, let me advert to others of an older date, possessing as I conceive, the strongest internal evidence in their favour, which the case admits, from the harmony they tend to introduce into the chaos of facts which the late discoveries in organic chemistry have brought to light. Amongst these, one of the most generally received, and at the same time one of the most universal application, is that which represents the several combinations resulting from organic forces, as being put together according to a particular model or type, which impresses upon the aggregate formed certain common properties, and also causes it to undergo change most readily, through the substitution of some other element in the place of one of those which already enters into its constitution. And this principle, having been established with regard to one class of bodies, has since been extended to the rest; for it now begins to be maintained, that in every case of chemical decomposition a new element is introduced in the place of one of those which constituted a part of the original compound, so that the addition of a fresh ingredient is necessarily accompanied by the elimination of an old one. The same doctrine, too, has even been extended to the case of combination with a body regarded as elementary, for here also the particles are considered as being in a state of binary combination one with the other, owing perhaps to their existing in opposite electrical conditions, and therefore possessing for each other a certain degree of chemical affinity. Thus, when we unite hydrogen with oxygen, we substitute an atom of the latter for one of the former, previously combined with the same element.

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To the microscope we owe all that is as yet known with respect to the reproductive process in cryptogamous plants, which are now shown to possess a structure analogous to that of flowering ones in respect to their organs of reproduction; not, indeed, as Hedwig supposed, that parts corresponding to stamens and pistils in appearance and structure can be discovered in them, but that as the primary distinction of sexes seems to run throughout the Vegetable Kingdom, new parts are superadded to a structure common to all as we ascend in the scale of creation, until from the simple cell, which, in consequence of some differences of structure, to our eyes inappreciable, appears to exercise in one case the function of the male, in another of the female, as is found the case in certain of the Confervæ, we arrive

at length at the complicated machinery exhibited in flowering plants, in which the cell containing the fecundating principle is first matured in the stamen, and afterwards transmitted, through an elaborate apparatus, to the cells of the ovule, which is in like manner enveloped in its matrix, and protected by the series of investing membranes which constitutes the seed-vessel. Thus, as Goethe long ago observed, and as modern physiologists have since shown to be the case, the more imperfect a being is, the more its individual parts resemble each other—the progress of development, both in the Animal and Vegetable Kingdoms, always proceeding from the like to the unlike, from the general to the particular. But whilst the researches of Brown and others have shown that there is no abrupt line of division in the Vegetable Kingdom, and that one common structure pervades the whole, the later inquiries of Suminski, Hofmeister, Unger, Griffith, and Henfrey, have pointed out several curious and unlooked-for analogies between plants and animals. I may mention, in the first place, as an instance of this analogy between plants and animals, the existence of moving molecules, or phytosperms, in the antheridia of ferns and other Cryptogams, borne out, as it has been in so remarkable a manner, by the almost simultaneous observations of Bischoff and Meissner on the egg, confirmatory of those formerly announced by Barry and Newport, and by the researches of Suminski, Thuret, and Pringsheim, with respect to the ovule of plants. I may refer you also to a paper read at the last Meeting of the Association, by Dr. Cohn, of Breslau, who, in bringing this subject before the Natural History Section, adduced instances of a distinction of sexes which had come under his observation in the lower Algæ. In like manner a curious correspondence has been traced between the lower tribes of animals and plants, in the circumstance of both being subject to the law of what is called alternate generation. This consists in a sort of cycle of changes from one kind of being to another, which was first detected in some of the lower tribes of animals; a pair of insects, for example, producing a progeny differing from themselves in outward appearance and internal structure, and these reproducing their kind without any renewed sexual union,—the progeny in these cases consisting of females only. At length, after a succession of such generations, the offspring reverts to its primæval type, and pairs of male and female insects, of the original form, are reproduced, which complete the cycle, by giving rise in their turn to a breed presenting the same characters as those which belong to their own progenitors. An ingenious comparison had been instituted by Owen and others between this alternation of generations in the animal, and the alternate production of leaves and blossoms in the plant; but the researches to which I especially allude have rendered this no longer a matter of mere speculation or inference, inasmuch as they have shown the same thing to occur in ferns, in lycopodia, in mosses, nay, even in the confervæ. We are indebted to Prof. Henfrey for a valuable contribution to our Transactions in 1851 on these subjects, given in the form of a Report on the Higher Cryptogamous Plants; from which it at least appears that the proofs of sexuality in the Cryptogamia rank in the same scale, as to completeness, as those regarding flowering plants did before the access of the pollen tubes to the ovule had been demonstrated. Indeed, if the observations of Pringsheim with respect to certain of the Algæ are to be relied upon, the analogy between the productive process in plants and animals is even more clearly made out in these lower tribes than it is in those of higher organization. It also appears that the production in ferns and other Acrogens of what has been callled a *pro-embryo;* the evolution of antheridia and archegonia, or of male and female organs, from the former; and the generation from the archegonia

of a frond bearing spores upon its under surface, is analogous to what takes place in flowering plants in general; where the seed, when it germinates, produces stem, roots, and leaves; the stem for many generations gives rise to nothing but shoots like itself; until at length a flower springs from it, which contains within itself for the most part the organs of both sexes united, and, therefore, occasions the reproduction of the same seed with which the chain of phenomena commenced. This is the principle which a learned Professor at Berlin has rather obscurely shadowed out in his treatise on the Rejuvenescence of Plants, and which may perhaps be regarded as one, at least, of the means by which Nature provides for the stability of the forms of organic life she has created, by imparting to each plant a tendency to revert to the primeval type.

To the elder De Candolle we are also indebted for some of our most philosophical views with respect to the laws which regulate the distribution of plants over the globe,—views which have been developed and extended, but by no means subverted, by the investigations of subsequent writers; amongst whom Sir Charles Lyell, in his 'Principles of Geology,' and the younger De Candolle, a worthy inheritor of his father's reputation, in his recently published work on Botanical Geography, have espescially signalized themselves. But it is to the late Prof. Edward Forbes, and to Dr. Joseph Hooker, that we have principally to attribute the removal of those anomalies, which threw a certain degree of doubt upon the principles laid down by De Candolle in 1820, in his celebrated article on the Geography of Plants, contained in the 'Dictionnaire des Sciences Naturelles,' where the derivaion of each species from an individual, or a pair of individuals, created in one particular locality, was made the starting point of all our inquiries. These anomalies were of two different kinds, and pointed in two opposite directions: for we had in some cases to explain the occurrence of a peculiar Flora in islands cut off from the rest of the world, except through the medium of a wide intervening ocean; and in other cases to reconcile the fact of the same or of allied species being diffused over vast areas, the several portions of which are at the present time separated from each other in such a manner, as to prevent the possibility of the migration of plants from one to the other. Indeed, after making due allowances for those curious contrivances by which Nature has in many instances provided for the transmission of species over different parts of the same continent, and even across the ocean, and which are so well pointed out in De Candolle's original essay, we are compelled to admit the apparent inefficiency of existing causes to account for the distribution of the larger number of species; and must confess that the explanation fails us often where it is most needed, for the Compositæ in spite of those feathery appendages they possess, which are so favorable to the wide dissemination of their seeds, might be inferred, by their general absence from the fossil Flora, to have diffused themselves in a less degree than many other families have done. And on the other hand, it is found, that under existing circumstances, those Compositæ, which are disseminated throughout the area of the Great Pacific, belong in many cases to species destitute of these auxiliaries to transmission. But here Geology comes to our aid; for by pointing out the probability of the submergence of continents on the one hand, and the elevation of tracts of land on the other, it enables us to explain the occurrence of the same plants in some islands or continents now wholly unconnected, and the existence of a distinct Flora in others too isolated to obtain it under present circumstances from without. In the one case we may suppose the plants to have been distributed over the whole area before its several parts became

disunited by the catastrophes which supervened; in the other, we may regard the peculiar Flora now existing as merely the wreck, as it were, of one which once overspread a large tract of land, of which all but the little patch on which it is now found had been since submerged. Upon this subject our opinions may in some measure be swayed by the nature of the conclusion we arrive at with respect to the length of time during which seeds are capable of mantaining their vitality; for if after remaining for an indefinite period in the earth they were capable of germinating, it would doubtless be easier to understand the revival, under favorable circumstances, of plants which had existed before the severance of a tract of land from the continent in which they are indigenous. An inquiry has accordingly been carried on for the last fifteen years under the auspices of, and with the aid of funds supplied by, this Association, the results of which, it is but fair to say, by no means corroborate the reports that had been from time to time given us with respect to the extreme longevity of certain plants, exemplified, as it was said, in the case of the mummy-wheat and other somewhat dubious instances; inasmuch as they tend to show, that none of the seeds which were tested, although they were placed under the most favorable artificial conditions that could be devised, vegetated after a period of forty-nine years; that only twenty out of 288 species did so after twenty years; whilst by far the larger number had lost their germinating power in the course of ten. These results, indeed, being merely negative, ought not to outweigh such positive statements on the contrary side as come before us recommended by respectable authority, such, for instance, as that respecting a Nelumbium seed, which germinated after having been preserved in Sir Hans Sloane's Herbarium for 150 years; still, however, they throw suspicion as to the existence in seeds of that capacity of preserving their vitality almost indefinitely, which alone would warrant us in calling to our aid this principle in explaining the wide geographical range which certain species of plants affect.

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Amongst the many services rendered to the Natural Sciences by Dr. Hooker, in conjunction with his fellow traveller, Dr. Thomson, one of the greatest I conceive to be, that they have not only protested against that undue multiplication of species, which had taken place by exalting minute points of difference into grounds of radical and primary distinction, but that they have also practically illustrated their views with respect to the natural families which have been described by them in the volume alluded to. They have thus contributed materially to remove another difficulty which stood in the way of the adoption of the theory of specific centres, —I mean the replacement of forms of vegetation in adjoining countries by others, not identical, but only as it should seem allied; for it follows from the principles laid down by these authors, that such apparently distinct species may after all have been only varieties, produced by the operation of external causes acting upon the same species during long periods of time.

But if this be allowed, what limits, it may be asked, are we to assign to the changes which a plant is capable of undergoing,—and in what way can we oppose the principle of the transmutation of species, which has of late excited so much attention, and the admission of which is considered to involve such startling consequences? I must refer you to the writings of modern physiologists for a full discussion of this question. All that I shall venture to remark is, that had not Nature herself assigned certain boundaries to the changes which plants are capable of undergoing, there would seem no reason why any species at all should be restricted

within a definite area, since the unlimited adaptation to external conditions which it would then possess might enable it to diffuse itself throughout the world, as easily as it has done over that portion of space within which it is actually circumscribed. Dr. Hooker instances certain species of Coprosma, of Celmisia, and a kind of Australian Fern, the *Lomaria procera*, which have undergone such striking changes in their passage from one portion of the Great Pacific to another, that they are scarcely recognizable as the same, and have actually been regarded by preceding botanists as distinct species. But he does not state that any of these plants have ever been seen beyond the above-mentioned precincts; and yet if Nature had not imposed some limits to the susceptibility of change, one does not see why they might not have spread over a much larger portion of the earth, in a form more or less modified by external circumstances. The younger De Candolle, in his late admirable treatise already referred to, has enumerated about 117 species of plants which have been thus diffused over at least a third of the surface of the globe, but these apparently owed their power of transmigration to their insusceptibility of change, for it does not appear that they have been much modified by the effect of climate or locality, notwithstanding the extreme difference in the external conditions to which they were subjected. On the other hand, it seems to be a general law, that plants whose organization is more easily affected by external agencies become from that very cause, more circumscribed in their range of distribution; simply because a greater difference in the circumstances under which they would be placed brought with it an amount of change in their structure which exceded the limits prescribed to it by Nature. In short, without pretending to do more than to divine the character of those impediments, which appear ever to prevent the changes of which a plant is suceptible from proceeding beyond a certain limit, we seem to catch a glimpse of a general law of Nature, not limited to one of her kingdoms, but extending everywhere throughout her jurisdiction,—a law, the aim of which may be inferred to be that of maintaining the existing order of the universe, without any material or permanent alteration, throughout all time, until the fiat of Omnipotence has gone forth for its destruction. The will which confines the variations in the vegtable structure within a certain range, lest the order of creation should be disturbed by the introduction of an indefinite number of intermediate forms is apparently the same in its motive as that which brings back the celestial luminaries to their original orbits, after the completion of a cycle of changes induced by their mutual perturbations; it is the same which says to the ocean, Thus far shalt thou go, and no further; and to the winds, Your violence, however apparently capricious and abnormal, shall nevertheless be constrained within certain prescribed limits—

> Ni faciat, maria et terras cœlumque profundum,
> Quippe ferant rapidi secum, verrantque per auras.

The whole, indeed, resolves itself into, or at least is intimately connected with, that law of symmetry to which Nature seems ever striving to conform, and which possesses the same significance in the organic world, which the law of definite proportions does in the inorganic. It is the principle which the prophetic genius of Goethe had divined, long before it had been proved by the labours of physiologists to be a reality, and to which the poet attached such importance, that the celebrated discussion as to its merits which took place in 1830 between Cuvier and Geoffry St. Hilaire so engrossed his mind, as to deprive him, as his biographer informs us, of all interest in one of the most portentous political events of modern days which was enacting at the very same epoch,—I mean the subversion of the Bourbon dynasty.

It is, indeed, not less calculated to subserve to the gratification of our sense of the Beautiful than to provide against too wide a departure from that order of creation which its great Author has from the beginning instituted; and, as two learned Professors of a sister kingdom have pointed out in Memoirs laid before this Association, and have since embodied in a distinct treatise, manifests itself not less in the geometrical adjustment of the branches of a plant, and of the scales of a fir-apple —nay even, as they have wished to prove, in the correspondence between the form of the fruit and that of the tree on which it grows—than in the frequent juxtaposition of the complimentary rays of the spectrum, by which that harmony of colour is produced in Nature which we are always striving, however unsuccessfully, to imitate in Art. The law, indeed, seems to be nothing else than a direct consequence of that unity of design pervading the universe, which so bespeaks a common Creator—of the existence in the mind of the Deity of a sort of archetype, to which His various works have all, to a certain extent, been accommodated; so that the earlier forms of life may be regarded as types of those of latter creation, and the more complex ones but as developments of rudimentary parts existing in the more simple.

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I might be disposed to claim for the recent investigations of botanists some share in fixing the relative antiquity of particular portions of the globe, for from the Floras they have given us of different islands in the Great Pacific, it would appear that the families of plants which characterize some groups are of a more complicated organization than those of another. Thus, whilst Otaheite chiefly contains Orchids, Apocyneæ, Asclepiadeæ, and Urticeæ; the Sandwich Islands possess Lobeliaceæ and Goodenoviæ; and the Galapagos Islands, New Zealand and Juan Fernandez, Compositæ, the highest form, perhaps, of dicotyledonous plants. In deducing this consequence, however, I am proceeding upon a principle which has lately met with opposition, although it was formerly regarded as one of the axioms in Geology. Amongst these, indeed, there was none which a few years ago seemed so little likely to be disputed as that the classes of animals and vegetables which possessed the most complicated structure were preceded by others of a more simple one; and that when we traced back the succession of beings to the lowest and the earliest of the sedimentary formations, we arrived at length at a class of rocks, the deposition of which must be inferred, from the almost entire absence of organic remains, to have followed very soon after the first dawn of creation. But the recognition of the footsteps and remains of reptiles in beds of an earlier date than was before assigned to them, tended to corroborate the inferences which had been previously deduced from the discovery, in a few rare instances, in rocks of the secondary age, of mammalian remains; and thus has induced certain eminent geologists boldly to dispute, whether from the earliest to the latest period of the earth's history any gradation of beings can in reality be detected. Into this controversy I shall only enter at present, so far as to point out an easy method of determining the fact, that organic remains never can have existed in a particular rock, even although it may have been subjected to such metamorphic action as would have obliterated all traces of their presence. This is simply to ascertain that the material in question is utterly destitute of phosphoric acid; for inasmuch as every form of life appears to be essentially associated with this principle, and as no amount of heat would be sufficient to dissipate it when in a state of combination, whatever quantity of phosphoric acid had in this manner been introduced into the rock, must

have continued there till the end of time, notwithstanding any igneous operations which the materials might have afterwards undergone. But as the discovery of very minute traces of phosphoric acid, when mixed with the other ingredients of a rock, is a problem of no small difficulty, an indirect method of ascertaining its presence suggested itself to me in some experiments of the kind which I have instituted, namely, that of sowing some kind of seed, such for instance as barley, in a sample of the pulverized rock, and determining whether the crop obtained yielded more phosphoric acid than was present in the grain, it being evident that any excess must have been derived from the rock from which it drew its nourishment. Should it appear by an extensive induction of particulars, that none of the rocks lying at the base of the Silurian formation, which have come before us, contain more phosphoric acid than the minute quantity I detected in the slates of Bangor and Llanberris, which were tested in the above manner, it might perhaps be warrantable hereafter to infer that we had really touched upon those formations, that had been deposited at a time when organic beings were only just beginning to start into existence, and to which therefore, the term Azoic, assigned to these rocks by some of the most eminent of our geologists, might not be inappropriate. The proofs of the former extension of glaciers in the Northern hemisphere, far beyond their actual limits, tend also to complicate the question which has at all times so much engaged the attention of cosmogonists with respect to the ancient temperature of the earth's surface, compelling us to admit that, at least during the latter of its epochs, oscillations of heat and cold must have occurred, to interfere with the progress of refrigeration which was taking place in the crust. On the other hand, facts of an opposite tendency, such as the discovery announced at our last meeting by Capt. Belcher, of the skeleton of an Ichthyosaurus in lat. 77°, and of the trunk of a tree standing in an erect position in lat. 75°, have been multiplying upon us within the same period; inasmuch as they appear to imply, that a much higher temperature in former times pervaded the Arctic regions that can be referred to local causes, and therefore force upon us the admission, that the internal heat of the nucleus of our globe must at one time have influenced in a more marked manner than at present the temperature of its crust.

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Twenty years ago it was thought necessary to explain at our meetings the character and objects of this Association, and to vindicate it from the denunciations fulminated against it by individuals, and even by parties of men, who held it up as dangerous to religion, and subversive of sound principles in theology. Now so marked is the change in public feeling, that we are solicited by the clergy, no less than by the laity, to hold our meetings within their precincts; and we have never received a heartier welcome than in the city in which we are now assembled, which values itself so especially, and with such good reason, on the extent and excellence of its educational establishments. It begins, indeed, to be generally felt, that amongst the faculties of the mind, upon the development of which in youth success in after life mainly depends, there are some which are best improved through the cultivation of the Physical Sciences, and that the rudiments of those sciences are most easily acquired at an early period of life. That power of minute observation —those habits of method and arrangement—that aptitude for patient and laborious inquiry—that tact and sagacity in deducing inferences from evidence short of demonstration, which the Natural Sciences more particularly promote, are the fruits of early education, and acquired with difficulty at a later period. It is during child-

hood, also, that the memory is most fresh and retentive and that the nomenclature of the sciences, which, from its crabbedness and technicality, often repels us at a more advanced age, is acquired almost without an effort. Although, therefore it can hardly be expected that the great schools in the country will assign to the Natural Sciences any important place in their systems of instruction until the Universities for which they are the seminaries set them the example, yet I cannot doubt but that, the signal once given, both masters and scholars will eagerly embrace a change so congenial to the tastes of youth, and so favorable to the development of their intellectual faculties. And has not, it may be asked, the signal been given by the admission of the Physical Sciences into the curriculum of our academical education? I trust that this question may be answered in the affirmative, if we are entitled to assume that the recognition of them which has already taken place will be constantly followed up by according to them some such substantial encouragement as that which has been afforded hitherto almost exclusively to classical literature. Our ability to accomplish this, with the means and appliances at our command, does not, I think, admit of dispute. All, therefore, that seems wanted, is, on the one hand, a more equal distribution of the existing emoluments between the several professions, and on the other, the admission of the claims of the sciences received into our educational system to share in the emoluments which up to this time, have been monopolized by the Classics. And, as it is far from my wish to curtail the older studies of the University of their proper share of support—fo who that has passed through a course of academical study can be insensible of the advantages he has derived from that early discipline of the mind which flows from their cultivation?—I rejoice to think, that when the Legislature shall have completed the removal of those restrictions which have hitherto prevented us in many instances from consulting the claims of merit in the distribution of our emoluments, there will be ample means afforded for giving all needful encouragement to the newly-recognized studies, without trenching unduly upon that amount of pecuniary aid which has been hitherto accorded to the classics. In anticipation of which change, I look forward with confidence to the day when the requirements at Oxford in the department of Physical Sciences will become so general and so pressing, that no institution which professes to prepare the youth it instructs for academical competition will venture to risk its reputation by declining to admit these branches of study into its educational courses.

ON THE THEORY OF COMPOUND COLOURS WITH REFERENCE TO MIXTURES OF BLUE AND YELLOW LIGHT. BY MR. J. C. MAXWELL.

When we mix together blue and yellow paint, we obtain green paint. This fact is well known to all who have ever handled colours; and it is universally admitted that blue and yellow make green. Red, yellow, and blue being the primary colours among painters, green is regarded as a secondary colour, arising from the mixture of blue and yellow. Newton, however, found that the green of the spectrum was not the same thing as the mixture of two colours of the spectrum, for such a mixture could be separated by the prism, while the green of the spectrum resisted further decomposition. But still it was believed that yellow and blue would make a green, though not that of the spectrum. As far as I am aware, the first experiment on the subject is that of M. Plateau, who, before 1819, made a disc with alternate sectors of Prussian blue and gamboge, and observed that, when spinning, the resultant tint was not green, but a neutral grey, inclining

sometimes to yellow or blue, but never to green. Prof. J. D. Forbes, of Edinburgh, made similar experiments in 1849, with the same result. Prof. Helmholtz, of Königsberg, to whom we owe the most complete investigation on visible colour, has given the true explanation of this phenomenon. The result of mixing two coloured powders is not by any means the same as mixing the beams of light which flow from each separately. In the latter case we receive all the light which comes either from the one powder or the other. In the former, much of the light coming from one powder falls on a particle of the other, and we receive only that portion which has escaped absorption by one or other. Thus, the light coming from a mixture of blue and yellow powder, consists partly of light coming directly from blue particles or yellow particles, and partly of light acted on by both blue and yellow particles. This latter light is green, since the blue stops the red, yellow, and orange, and the yellow stops the blue and violet. I have made experiments on the mixture of blue and yellow *light*—by rapid rotation, by combined reflection and transmission, by viewing them out of a focus, in stripes, at a great distance, by throwing the colours of the spectrum on a screen, and by receiving them into the eye directly; and I have arranged a portable apparatus by which any one may see the result of this or any other mixture of the colours of the spectrum. In all these cases blue and yellow do *not* make green. I have also made experiments on the mixture of coloured powders. Those which I used principally were "mineral blue" (from copper) "and chrome yellow." Other blue and yellow pigments gave curious results, but it was more difficult to make the mixtures, and the greens were less uniform in tint. The mixtures of these colours were made by weight, and were painted on discs of paper, which were afterwards treated in the manner described in my paper 'On Colour as perceived by the Eye, in the *Transactions of the Royal Society of Edinburgh*, Vol. XXI., Part 2. The visible effect of the colour is estimated in terms of the standard-coloured papers: —vermilion (V,) ultramarine (U,) and emerald green (E.) The accuracy of the results, and their significance, can be best understood by referring to the paper before mentioned. I shall denote mineral blue by B, and chrome yellow by Y; and B_3 Y_5 means a mixture of three parts blue and five parts yellow.

Given Colour.				Standard Colours.			Co-efficient.
				V.	U.	E.	
	B_8	100	=	2	36	7	45
B_7	Y_1	100	=	1	18	17	37
B_6	Y_2	100	=	4	11	34	49
B_5	Y_3	100	=	9	5	40	54
B_4	Y_4	100	=	15	1	40	56
B_3	Y_5	100	=	22	−2	44	64
B_2	Y_6	100	=	35	−10	51	76
B_1	Y_7	100	=	64	−19	64	109
	Y_8	100	=	180	−27	124	277

—The columns V., U., E. give the proportions of the stardard colours which are equivalent to 100 of the given colour; and the sum of V., U., E. gives a co-efficient, which gives a general idea of the brightness. It will be seen that the first admixture of yellow *diminishes* the brightness of the blue. The negative values of U. indicate that a mixture of V., U., and E. cannot be made equivalent to the given colour. The experiments from which these results were taken had the negative

values transferred to the other side of the equation. They were all made by means of the colour-top, and were verified by repetition at different times.

"ON SOME DICHROMATIC PHENOMENA AMONG SOLUTIONS, AND THE MEANS OF REPRESENTING THEM," BY DR. GLADSTONE.

This paper was an extension of Sir John Herschel's observations on dichromatism, that property whereby certain bodies appear of a different colour according to the quantity seen through. It depends generally on the less rapid absorption of the red ray as it penetrates a substance. A dichromatic solution was examined by placing it in a wedge-shaped glass-trough, held in such a position that a slit in a window-shutter was seen traversing the varying thicknesses of the liquid. The diversely coloured line of light thus produced was analyzed by a prism; and the resulting spectrum was represented in a diagram by means of coloured chalks on black paper, the true position of the apparent colours being determined by the fixed lines of the spectrum. In this way the citrate and comenamate of iron, sulphate of indigo, litmus in various conditions, cochineal, and chromium, and cobalt salts where examined and represented. Among the more notable results were the following:—A base, such as chromic oxide, produces very nearly the same spectral image with whatever acid it may be combined, although the salts may appear very different in colour to the unaided eye. Citrate of iron appears green, brown, or red, according to the quantity seen through. It transmits the red ray most easily, then the orange, then the green, which covers the space usually occupied by the yellow; it cuts off entirely the more refrangible half of the spectrum. Neutral litmus appears blue or red, according to the strength or depth of the solution. Alkalies cause a great development of the blue ray; acids cause a like increase of the orange, while the minimum of luminosity is altered to a position much nearer the blue. Boracic acid causes a development of the violet. Alkaline litmus was exhibited so strong that it appeared red, and slightly acid litmus so dilute that it looked bluish purple; indeed, on account of the easy transmissibility of the orange ray through an acid solution, the apparent paradox was maintained that a large amount of alkaline litmus is of a purer red than acid litmus itself. Another kind of dichromatism was examined, dependent not on the actual quantity of coloured material, but on the relative proportion of the solvent. Diagrams of the changing appearances of sulphocyanide of iron, of chloride of copper, and of chloride of cobalt were exhibited.

"ON A METHOD OF DRAWING THE THEORETICAL FORMS OF FARADAY'S LINES OF FORCE WITHOUT CALCULATION," BY MR. J. C. MAXWELL.

The method applies more particularly to those cases in which the lines are entirely parallel to one plane, such as the lines of electric currents in a thin plate, or those round a system of parallel electric currents. In such cases, if we know the forms of the lines of force in any two cases, we may combine them by simple addition of the functions on which the equations of the lines depend. Thus the system of lines in a uniform magnetic field is a series of parallel straight lines at equal intervals, and that for an infinite straight electric current perpendicular to the paper is a series of concentric circles whose radii are in geometric progression. Having drawn then two sets of lines on two separate sheets of paper and laid a third piece above, draw a third set of lines through the intersections of the first and second sets. This will be the system of lines in a uniform field disturbed by an electric current. The most interesting cases are those of uniform fields dis-

turbed by a small magnet. If we draw a circle of any diameter with the magnet for centre, and join those points in which the circle cuts the lines of force, the straight lines so drawn will be parallel and equi-distant, and it is easily shewn that they represent the actual lines of force in a paramagnetic, diamagnetic, or crystallized body, according to the nature of the original lines, the size of the circle, &c.

ON THE FORM OF LIGHTNING.

Mr. J. Nasmyth read a paper to the effect that the form of lightning as exhibited by nature was an irregular curved line, shooting from the earth below to the cloud above, and often continued from the cloud downwards again to some distant point of the earth; and this appearance was the result of the rapidly-shooting point of light, which constituted the true lightning, leaving on the eye the impression of the path it traced. These views led to much discussion in the Section.

(To be continued.)

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The Tenth Meeting of the American Association for the Advancement of Science was opened at Albany, in the Capitol of the State of New York, on the 20th of August, by Professor James B. Hall. A deputation from Montreal was introduced to the association on the following day, and Principal Dawson of McGill College, in the name of the deputation, communicated the invitation to the Association,—which at a subsequent meeting was accepted,—that the next meeting should be held in Montreal.

The American Association is still on a much smaller scale than its British prototype; and in some respects presents characteristic differences. The arrangements of business, which are left in the British Association exclusively in the hands of the Central Committee, were at Albany repeatedly made the subject of discussion by the whole body; and a good deal of time was lost in debates in general meeting, upon questions of order and constitutional forms, little calculated to interest those who had been attracted from a distance by the desire to listen to the communications of the distinguished representatives of American Science assembled on the occasion. Another characteristic, which could scarcely fail to strike those who are familiar with the proceedings of the British Association, was the absence of that numerous body of youthful aspirants for a place among the ranks of the Scientific Legion, which constitutes so valuable a feature in the Sections at Home. Already, chairs in the Colleges of England, Scotland, and Ireland, are filled by those who owed their first introduction to the Scientific world to the Sections of the British Association; and not the least of the benefits traceable to that institution pertain to this important feature of its organization, which has been so employed as to invite the younger students of Science into the arena, and stimulate them to compete with those whose rank has long been established by universal consent. The American Association on the contrary seems chiefly composed of the veterans of Science; nor was there wanting some appearance of an apprehension of any greater infusion of the popular element, such as the influence of the political institutions of that Country on all large and some-

what miscellaneous assemblies may perhaps fully justify. But whatever may be the effects of this absence of the predominating element of youthful aspirants for honors in the field of Scientific adventure, the assembly of so many of the most distinguished representatives of American Scientific Veterans, was a peculiarly acceptable feature to those who were allured from other countries, by the echo of their fame. Nor must it be overlooked that in whatever other respects the popular element may work, it is scarcely possible for a warmer or more hospitable welcome to be offered any where, than that which the citizens of Albany, and the Official representatives of the State of New York, tendered to the assembled Congress of American Science, and to the visitors attracted by the justly earned reputation of its members.

The great feature of interest at this meeting was the inauguration of the Dudley Astronomical Observatory. This observatory has been founded by the liberality of some citizens of Albany, among whom Mrs. Dudley, whose name it bears, has not only contributed upwards of $25,000 for the building and instruments but has announced a further donation of $50,000 towards its permanent endowment. The Hon. Edward Everett delivered a splendid oration on the occasion, in the presence of the Association, the dignitaries of the State, and the citizens of Albany, the venerable foundress herself occupying the seat of honour. The observatory is built in a solid and massive style, and finely situated on the brow of a hill; its erection was superintended by a committee of eminent astronomers, and the construction of the instruments was entrusted to Dr. Gould, who has accepted the appointment of Director. At a meeting in Section, Dr. Gould described in detail the new instruments. The minor instruments have been received, and the Observatory has been fitted up with these and others lent by Prof. Bache from the Coast Survey, but the reception of the larger instruments will be delayed for a few weeks longer. The Transit circle, combining in one the Transit telescope and meridian circle, was ordered from Pistor and Martius, the celebrated manufacturers of Berlin, by whom the new instrument at Ann Arbor was made. A number of improvements have been introduced in the Albany instruments, not perhaps all absolutely new, but an eclectic combination of late adaptations with new improvements. Dr. Gould made a distinction of modern astronomical instruments into two classes, the English and the German. The English is the massive type; the German, light and airy. The English instrument is the instrument of the engineer; the German, the instrument of the artist. In ordering the instruments for the Albany Observatory, the Doctor had endeavoured to combine the two, with, however, a preference to the German type. The circle is three feet in diameter, graduated to intervals of two minutes, and read by micrometers to tenths of seconds. The microscopes are four in number, and are not carried by moveable frames, but are imbedded in the piers. The piers themselves completely surround the circle so as to eliminate the effect of changes of temperature by radiation. The tube of the telescope is eight feet in length, and the object glass is eight inches clear aperture. The glass was made by Chance, of Birmingham, and ground by Pistor himself. The eye-piece, in addition to the diaphragm, is furnished with two micrometers, one for vertical, the other for horizontal motion, the use of these being for the circumpolar stars, whose motion is too slow for registration by the Chronographic method. One principle has been adhered to in the whole of the instrumental arrangements, namely: that every error is capable of being determined in two independent ways.

Much trouble was experienced in securing a good casting for the steel axis of the instrument. Three were found imperfect under the lathe, and the fourth was chosen, but even then, the pivots were made in separate pieces, which were set in very deeply, and welded.

Dr. GOULD said he would have preferred a smaller instrument, in which the facilities of manipulation would have been greater, but was hampered by one proviso, upon which the Trustees of the institution insisted—that this should be the biggest instrument of its kind, and the instruction was obeyed. He had been requested by the gentlemen who had this enterprise in charge, to suggest, as a mark of respect to a gentleman of Albany, who was a munificent patron of Science, that this instrument be known as the Olcott Meridian Circle. The other large instrument for the Observatory, the Heliometer, has been entrusted to an American artist, but is not yet completed. It was also announced that the American Astronomical Journal, hitherto supported at Dr. GOULD's own expense, was in future to be published at Albany, under Dr. GOULD's editorship, the responsibility of its cost having been assumed by a number of gentlemen of that City.

Among the Astronomical papers read before the Association was one by Dr. PETERS on a *Periodical Comet of thirteen years.* This Comet was discovered by Dr. PETERS, at Naples, in 1846. He has prepared an ephemeris of the Comet from 1857 to 1860. The comet was very difficult to observe; its light was so faint in 1846 that he could not perceive it until he had reposed his eye for some seconds in darkness. Even under these circumstances he had only seen it at intervals during a period of twenty days. He had devoted some time to calculating where the comet might be looked for on its re-appearance, and had drawn lines on a map, from eight days to eight days, so that the observer would be saved much of the labor of sweeping, and the comet could readily be discovered. The probable orbit gives an ellipse of thirteen years, with a probable error of one year, so that its period might be twelve or fourteen years. In 1854, Saturn came into nearly the same position as this comet, and some uncertainty exists as to its distance, it having been difficult to ascertain whether it was nearer the interior or the exterior of that planet. Unless some accident had happened, the comet might be looked for either fifty-six days before or fifty-six days after the 15th of March, 1859. This enquiry had become of more importance since two comets pronounced periodic, those of de Vico and Brünnow, had failed to re-appear. Dr. PETERS remarked that the discovery of comets has decreased. Last year, not more than one or two were discovered. He thought this falling-off is owing partly to the fact that the award of a comet medal has been abandoned by the King of Denmark. For many years, the discoverer of any telescopic comet received a comet-medal from the King, but in 1848 the custom was abolished, and the zeal for discovery has since declined. He hoped the institution of the comet-medal would be renewed here.

Dr. GOULD observed that it was not a little curious that since the establishment of the Observatory at Pultowa the realm of Denmark had contributed 200 per cent. more to the progress of astronomical science, in proportion to its population, than any other country. The comet medal, whose institution was suggested by Schumacher, continued to be awarded for fifteen years, during which period the discoveries of comets averaged five to seven per annum, and the average discover-

ies of each comet by independent observers three to four. Since it has been abolished the discoveries of comets have not averaged over three per annum, and the independent simultaneous discoveries of the same comet have become exceedingly rare.

THE UNITED STATES COAST SURVEY.

The progress of this magnificent work has furnished, as usual, many valuable results in Science since the preceding meeting of the Association; the following abstracts of the Papers read will shew how great credit is due both to the energy and skill of the conductors of this undertaking, and to the wise liberality of the Government which supports it.

"The Distribution of Terrestrial Magnetism in the United States," by Prof. Bache and J. D. Hilgard.

The magnetic observations made in connection with the Survey were scattered, at 160 different stations, along the entire sea coast, and the data were reduced to the common period of the year 1850. The line of no variation, or that passing through all the places where the magnetic needle points to the true north, intersects the coast near Ocracoke, between Cape Hatteras and Cape Fear, in a N.N.W. direction, curving gradually to the North, and passing through the middle of Lake Erie.

To the north and east of this line the declination (or variation of the compass) is to the west of north, being 6° near New York, 10° near Boston, and 16° in the eastern part of Maine. To the south and west of the line of no variation it is east of north, being 8° east along a line running directly south a little to the west of St. Louis and New Orleans, 13° near San Diego, and 21° near Cape Flattery on the western coast. The dip of the needle varies from 75° in the North eastern States to 60° along the northern shore of the Gulf of Mexico, and the horizontal force from 3.5 to 6.0 in the same regions.

SUPPLEMENT TO THE PAPER PUBLISHED IN THE PROVIDENCE PROCEEDINGS, ON THE SECULAR VARIATION IN MAGNETIC DECLINATION IN THE ATLANTIC AND GULF COAST OF THE UNITED STATES, FROM OBSERVATIONS IN THE SEVENTEENTH, EIGHTEENTH AND NINETEENTH CENTURIES, UNDER PERMISSION OF THE SUPERINTENDENT. BY CHAS. A. SCHOTT.

In a paper communicated to the Association at the Providence meeting the secular change of the magnetic declination was investigated by Mr. Schott. In the course of last summer he made some additional observations by direction of the Superintendent of the Coast Survey, and in the paper now presented the results are combined with those previously obtained. The former deductions have gained considerably in accuracy, and have received important additions. The number of stations is increased from ten to thirteen. The recent observations appear to show a slight diminution in the rate of increase of westerly declination, leading to the supposition that the inflexion in the curve representing the secular variation corresponds to about 1850. All the observations concur in placing the minimum about 1800. The present rate of increase of westerly declination is about five minutes annually along the Atlantic coast.

DISCUSSION OF THE SECULAR VARIATION OF MAGNETIC INCLINATION IN THE NORTH-EASTERN STATES. COMMUNICATED, UNDER PERMISSION OF THE SUPERINTENDENT AND AUTHORITY OF THE TREASURY DEPARTMENT, BY CHARLES A. SCHOTT.

The results are confined to the limits of 38 deg. and 44 deg. of North latitude, there being too few observations in the southern part of the United States to permit

safe inferences there. The element of magnetic dip, though less important practically than that of declination, is of value in navigation in certain latitudes, and from its connection, through Gauss' investigations, with the declination and intensity, assumes a high degree of importance. While the declination observations on this coast go back to the seventeenth century, the dip has only been accurately observed for 23 years; for the earliest observations made in 1782 were, from the imperfection of the instruments, of little value. During this period the dip has decreased, reached a minimum, and begun again to increase, so that it has been a highly interesting period for observation. The lines of equal dip have been deduced by Professor Loomis, from the observations which he had accumulated before the date of his paper. The present memoir includes additional results, and discusses 161 observations made at the different stations between Toronto on the north, and Baltimore on the south. The average probable error of the result at any one station is about one minute and six-tenths of dip, and the time of minimum dip is ascertained to be about two years and seven-tenths. This time was the year 1843, or rather the close of 1842 (1842–7). Mr. Schott points out why these results do not agree with Professor Hansteen's, who had not observations enough to determine the epoch of minimum dip with accuracy. Observations on the Western coast confirm these results for the Eastern.

ON THE CAUSE OF THE INCREASE OF SANDY HOOK. BY PROF. BACHE.

It is well known, as one of the developments of the Survey, that the Hook is gradually increasing, growing to the northward into the main ship channel. At a spot north of the Hook, where there were forty feet of water when Captain Gedney made his survey, in less than ten years it was nearly bare. The importance of determining the cause of this increase, as leading to the means of controlling it cannot be over estimated. The Commissioners on Harbor Encroachments had early attended to the matter and requested that the necessary observations for its investigation should be made. These were under the immediate direction of Prof. Bache, the observations having been made by Henry Mitchell, one of the sub-assistants in the Coast Survey, with all desirable zeal and ability.

Various causes had been assigned for this growth from the action of the waves and the winds, sometimes on the outer side and sometimes on the inside of the Hook. The effect of the opening and closing of Shrewsbury inlet had also been insisted upon.

To examine these and other probable causes laborious observations of tides and currents had been made in the vicinity of stations which Prof. Bache showed upon the map. Careful measurements of the low water line had also been made in connection with these observations, and with others of the force and direction of the winds. Objects easily distinguished from the sand, and of various specific gravities and shapes, had been deposited near the shore of the Hook to determine the power and direction of transportation of matter along the shores of the Hook. The results of these observations have not yet been worked out in all their detail, but the conclusions from them are perfectly safe, and are of the highest importance. It turns out that this growth of the Hook is not an accidental phenomenon, but goes on regularly and according to determinable laws. The amount of increase depends upon variable causes, but the general fact is that it increases year by year, and the cause of this is a remarkable northwardly current, the amount and duration of which these observations assign along both shores of the Hook, the outer one extending across the whole breadth of False Hook channel, with varying velocity, and the one

inside of the Hook extending nearly one-third of the distance across Sandy Hook Bay. These currents run to the north, during both the ebb and flood tide, with varying rates, and result from those tides directly and indirectly. The inner current is the one by which the flood and ebb tides draw, by the lateral communication of motion, the water from Sandy Hook Bay, and the outer is similarly related to those tides as they pass False Hook channel. The velocities and directions found, favor this conclusively.

An important observation for navigation results from this, for eleven hours out of the twelve, there is a northwardly current running through False Hook channel, which assists vessels entering New York harbor on the ebb tide, and is to be avoided in passing out with the ebb.

It is the conflict of these two northwardly currents outside and inside, and the deposit of the materials which they carry to the point of the Hook, which causes its growth.

Within a century it has increased a mile and a quarter, and at about the rate of one sixteenth of a mile a year, on the average, for the last twelve years.

Flynn's Knoll, on the north side of the main ship channel, does not give way, as the point of the Hook advances. The importance of watching this movement cannot, therefore be over stated.

The mode of controlling the growth is obvious from the result obtained. The observations are still continued, to obtain the necessary numerical results.

APPROXIMATE COTIDAL LINES OF DIURNAL AND SEMI-DIURNAL TIDES OF THE COAST OF THE UNITED STATES ON THE GULF OF MEXICO—BY A. D. BACHE, SUPERINTENDENT UNITED STATES COAST SURVEY. COMMUNICATED BY AUTHORITY OF THE TREASURY DEPARTMENT.

This paper is supplementary to those on cotidal lines of the Atlantic and Pacific coasts heretofore communicated to the Association. Preparation was made at the last meeting for these conclusions by presenting the type curves of the Gulf coast The tides from Cape Florida to St. George's are of the usual type, with a large daily inequality. From St. George's to the mouth of the Mississippi they are of the single day type. Then the half-day tides reappear to extend beyond Galveston, the day tides recurring at Aransas, in Texas, and southward. When the type curves were presented, the mode of decomposing them with a diurnal and semi-diurnal wave was described. The tide stations extend along our whole coast, but observations are much wanted beyond it to complete the investigation, on the south side of the Straits of Florida, on the eastern coast of the Gulf of Mexico south of Texas, and especially between Cuba and Yucatan, at the entrance of the Gulf from the Caribbean sea.

A table of the stations at which the observations were made, of the heights of tide (rise and fall) observed, and of the half-day and day tides, was given; and another showing the period of observation and the name of the observer. The first table is represented on a diagram by which a navigator may find the rise and fall of tide approximately on any part of our Gulf coast. The least observed rise and fall is at Brazos Santiago, Texas, and is nine tenths of a foot. The greatest is at Cedar keys, Florida, and is two and a half feet. The difficulties of the problem presented by these tides are explained, removable in part by the progress of the survey of the Gulf, inherent in them in part. The labors of Mr. Pourtales and other gentlemen concerned in the discussion of these tides are acknowledged. The single-day tides have not been so elaborately discussed by former physicists or mathe-

maticians as to prepare the way fully for this work. The formula for the times given by Professor Avery in his "Tides and Waves," when compared with the observed times, differs remarkably in certain parts of the lunar month. A diagram shows the general form of the curve of interval between the moon's transit and high water. Advantage is taken of the part of the curve which changes but little in ordinate to obtain an average luni-tidal interval corresponding in kind with the number for semi-diurnal tides, known at the establishment. These tides occur about the period of greatest declination of the moon. These intervals, at greatest declination, vary greatly during the year; and the form of curve showing the annual change is presented, as deduced from observations at key West, Fort Morgan (Mobile entrance), and Galveston, as well as from San Francisco, on the Western coast, where the results are remarkably regular. These annual curves are used to deduce the average number for the interval of the daily tides from the short series of observations; the limits of uncertainty of the process are pointed out. These intervals are next turned into cotidal hours by the usual process of correcting for the difference of longitude, for transit, for depth, and by the process just described for the annual change. A table of cotidal hours for the various stations is then given. By it the cotidal lines are traced, the tide waves entering the Straits of Florida, passing through them, crossing to the entrance of the Mississippi, and passing laterally to the western coast of the peninsula of Florida from south to north, and along the southern coast of Upper Florida, along the eastern coast of Louisiana from the Southwest Pass northward, and along the coast of Mississippi. Also, into the Gulf between Southwest pass and the Rio Grande, in such a way that Galveston has, as the head of the Gulf, the latest cotidal hour. By forming groups of stations, the direction of the cotidal lines, the mean cotidal hour, and the velocity of the wave's movement are roughly determined. The difficulties of forming the groups are explained, and the general character of the results given by them are shown in a table and upon a diagram map. Upon the map also are given the cotidal hours of the stations, and the results of the grouping. Finally, from the study of the groups and their connection, the cotidal lines or the daily tides are drawn upon the map. The main cotidal hour of the northern shore of the Gulf is twenty-six hours, twenty seven occurring at the head of the bight in which Galveston lies. The twenty-five hour line appears at Cedar Keys, and touches the coast again at Brazos Santiago. Twenty-three is at the Tortugas and Key West, and nineteen at Cape Florida.

A similar course to that just described is followed in the discussion of the semi-diurnal tides. The table of stations, their positions, and the other data necessary to obtain cotidal hours is given. The progress of the semi-diurnal wave as indicated by three hours is also shown. The general motion of the wave is like that of the diurnal wave, with very characteristic peculiarities. From the line of deep water joining the Tortugas and Southwest Pass at the entrance of the Mississipi the semi-diurnal wave reaches the stations on the western coast of the Florida peninsula in this order, from south to north and west. The movement west of St. George's appears to be in the order of Pensacola, Fort Morgan and Cat Island, while for the diurnal wave it was Cat Island, Fort Morgan, Pensacola. To the westward of Southwest Pass there is a sudden increase of establishment, as if another semi-diurnal wave brought the tides there. The mean cotidal hour of the five sections west of Southwest Pass is 20 h. 6 m., while that of Southwest Pass and three east of it is 16 h. 17 m., a difference of about four hours. This taken with

the remarks already made in regard to the appearance of two high waters in the curves for Isle Dernier and Calcasieu, indicate a system of interferences yet to be unravelled. As was the case with the diurnal wave, the stations at Isle Dernier and Calcasieu gave cotidal hours very like those of Brazos Santiago and Aransas, and Galveston is later then either.

The differences between the cotidal hours for the diurnal and semi-diurnal tides are shown in a table. The grouping of the semi-diurnal results is next made, and the results tabulated and drawn on a diagram map. This map also shows the cotidal lines deduced. The cotidal lines of thirteen and fourteen hours only appear on the coast of the Florida Keys; that of sixteen hours is well marked, near Egmont Key (Tampa), and passes around the shore of the great Bay, between Louisiana and Florida, to near Southwest Pass. The line of eighteen hours is at the head of the heights, between St. George's and Cedar keys, and seventeen in that near Cat Island; the lines of sixteen and twenty-one have succeeded each other closely in the bay to the westward of Southwest Pass.

In comparing the two sets of cotidal lines for the diurnal and semi-diurnal waves, we find a general resemblance in the great bay between the western coast of Florida and the eastern coast of Louisiana. The lines of 24, 25 and 26 of the diurnal tide on the eastern side of the bay, corresponding generally with 16, 17 and 18 of the semi-diurnal tides and 25 and 26 hours of the diurnal tide on the western side of the bay corresponding generally to 16 and 17 of the semi-diurnal. On the southern coast of Florida, by the Keys, on the contrary the lines of 19, 20, 21, 22 and 23 hours succeed each other rapidly between Cape Florida and the Tortugas, in the diurnal series, along the same shores in the semi-diurnal tide. On the contrary on the west of southwest Pass, the lines of 26, 27 and 28 hours only occura t considerable distances in the diurnal system, while 16, 17, 18, 19, 20 and 21 occur in the same space between Southwest Pass and Brazos Santiago in the same diurnal tide.

NOTES ON THE PROGRESS MADE IN THE COAST SURVEY, IN PREDICTION TABLES FOR THE TIDES OF THE UNITED STATES COAST, BY A. D. BACHE, SUPTD., ETC.

Communicated by authority of the Treasury Dept.

As soon as tidal observations had accumulated sufficiently to make the task a profitable one, I caused them to be treated, under my immediate direction, by the methods in most general acceptance. The observations at Old Point Comfort, Virginia, were among the earliest used for this purpose, and the labors of Commander Charles H. Davis, U. S. N., then an assistant in the coast survey, were directed to their reduction chiefly by the graphical methods pointed out by Mr. Whewell. This work was subsequently continued by Mr. Lubbock's method, by Mr. Henry Mitchell; and next the tides of Boston harbor were taken up as affording certain advantages in the observations themselves, which could not be claimed for those of Old Point.

The system of Mr. Lubbock is founded on the equilibrium theory, and in it the inequalities are sought by arranging the elements of the moon's and sun's motions, upon which they depend. Having obtained the coefficient of the half monthly inequality of the semi-diurnal tide at Boston, from seven years' observations, through the labors of the tidal division, and approximate corrections for the parallax and declination, I was much disappointed in attempting the verification by applying to individual tides for a year during which we had observations. There was a general agreement on the average but a discrepancy in the single cases, which was quite

unsatisfactory. Nor were these discrepancies without law, as representing their residuals by curves did not fail to show. By introducting corrections for declination and parallax of the moon increasing and decreasing, we reduced these discrepancies, but still the results were not sufficient approximations. With the numerical reductions of the observations before referred to, was commenced in 1853, under my immediate direction, by Mr. L. W. Meech, a study of the theory of the tides, directed chiefly to the works of Bernoulli, La Place, Avery, Lubbock and Whewell. The immediate object which I had in view was the application of the wave theory to the discussion of our observations. I thought that the mind of an expert mathematician, directed entirely to the theoretical portions of this work, with direction by a physicist, and full opportunities of verifying results by extended series of observations, the computations of which should be placed by others in any desired form, would give, probably, the best result in this combined physical and mathematical investigation.

The general form of the different functions expressing the tidal inequalities is the same in the different theories, and may be said on the average to be satisfactory as to the laws of change which these inequalities present. Whether we adopt, with La Place, the idea that periodical forces produce periodical effects, or with Avery, that the tidal wave arrives by two or more canals; or with Bernoulli and Lubbock, the results of an equilibrium spheroid; or with Whewell, make a series of inequalities, semi-menstrual, parallax and declination, with different epochs, we arrive at the same general results, that the heights and times of high water may be represented by certain functions, with indeterminate co-efficients, in the form of which the theories in a general way agree. By forming equations from the observations, and obtaining the numerical values of the co-efficients by the methods used so commonly in astronomical computations, the result is accomplished.

A general consideration of the co-ordinates in space of the moon and sun, without any special theory, would lead to the same result, representing the luni-tidal interval by a series of sines and co-sines, with indeterminate co-efficients.

The grouping of the observations of one year at Boston, to apply this method the formation of the equations and their solution by the method of indirect elimination has been the work of Mr. R. L. Avery.

To test the co-efficients, computations, for the predicted times of the tide at Boston harbor were made for a period from March 1853, to January 1854, and from comparison of these with the observed, it appears that in twenty pairs of tides, the morning and afternoon being grouped to get rid of the diurnal inequality, there are two differences of less than two 2 m., thirteen of more than 2 m. and less than 4 m., three of more than 4 m. and less than 10 m., two of more than 10 m. The probable error of the prediction of a single pair of tides is 4.12 m. so that greater accuracy of prediction has been attained by this method from a single years's observations that was found at London bridge from a period of nineteen years.

LAW OF MORTALITY.

Prof. McCoy, of Albany, read a paper in which he announced the important discovery of a mathematical formula which correctly expressed the law of mortality for all ages; it was first evolved from an analysis of the Carlisle and Northampton tables, but the Professor had compared it with a large number of others and said that, "so complete is its agreement with all, that at no age does the calculated number of the living differ from the number given in the tables by

a single year's mortality." The formula is, that, for the age x, the rate of mortality or the ratio of the dead to the living for that age is expressed by

$$a\,b^{c^{x}}$$

where, a, b, c, are constants which differ for different tables. From this the Professor drew the following conclusions;

1. The rate of mortality invariably increases from youth to old age.

2. This rate is continually accelerated even in a higher ratio than in geometrical progression.

3. In early manhood, the rate does not differ much from a slow arithmetical progression.

4. There are no crises or climacterics at which the chances for life are stationary or improving.

5. There are no periods of slow and rapid increase succeeding each other; but one steady, invariable progress.

6. The law, though not the rate of mortality, is the same for city and country, for healthy and unhealthy places, for every age and country and locality; and this law is that the differences of the logarithms of the rates of mortality are in geometrical progression.

OZONE OBSERVATION.

Prof. Rogers gave an account of some observations made by him on the existence of ozone in the atmosphere. In the first instance these were made at Boston, and he here found winds blowing from the sea heavily ozonised, while those from the land were less so; on removing, however, fifty miles inland, he found the indications of ozone apparently independent of the quarter from which the wind was blowing, and depending more on its velocity; in a calm there being but slight ozonic effect, the increase being marked with the violence of the wind. This was to have been expected from the imperfect character of the mode of observation, since the effect produced on the test paper would depend on the quantity of ozone brought in contact with it, and this of course depended on the quantity of air that passed over it in a given time. To remedy this defect, he had arranged an apparatus by which the number of cubic feet of air passing over the test paper could be measured.

Dr. Webster, of Norfolk, added an important observation, "*Last year, while the yellow fever was at Norfolk and Portsmouth, I kept an ozonometer constantly exposed to the air, and never detected ozone. This year I have used the ozonometer in the same place, and at the same period of time, and I find ozone in abundance.*"

THERMIC EFFECT OF THE SUN'S RAYS.

In a paper, by Mrs. Eunice Foote, some interesting results of experiments on this subject were given. The experiments were made by exposing freely to the Sun's rays a thermometer, with blackened bulb, enclosed in a glass receiver, which contained the various gases experimented on. The effect was found to be greatest of all in Carbonic Acid gas: for example, when in air the thermometer stood at 106°, in Hydrogen it stood at 104°; in Oxygen, at 108°, and in Carbonic Acid at 125°. It was also found that the thermic effect was increased in air by an increase of its density and also by an increase of the moisture in it.

(*To be continued.*)

MONTHLY METEOROLOGICAL REGISTER AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST, OCTOBER, 1856.

Latitude—43 deg. 39.4 min. North. Longitude—79 deg. 21 min. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Mean Temp. + or — of the Av'age.	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Result't. Direc-tion.	Direction of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M	2 P.M	10PM	ME'N		6 A.M	2 P.M	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A. M.	2 P. M	10 P. M.		6 A.M	2 PM.	10 P.M.	Re-sult'.	ME'N		
1	29.225	29.263	29.335	29.2805	° 40 0	° 50.0	° 43.0	° 44.63	° — 5 78	.213	.218	.200	.212	.87	.61	.72	.73	s w b w	s w b w	s w b s	° s 38 w	2.8	13.6	6.0	9.89	10.08	...	...
2	343	395	544	.4412	45.1	51.7	45.8	47.47	— 2 47	177	232	248	217	60	62	82	68	s w b s	s s w	s w	s 50 w	13.5	17.8	1.8	8.24	9.59	...	...
3	693	718	788	.7380	38.4	57.9	47.4	48.53	— 1.00	197	237	220	217	85	50	68	66	w n w	s w b s	s w	s 47 w	7.0	8.3	2.5	3.68	4.79	...	...
4	841	786	732	.7833	42.0	57.2	51.0	50.95	+ 1.92	235	288	305	285	89	62	83	78	n	e	n e b e	n 71 e	1.0	6.4	1.4	2.83	3.04	...	...
5	704	628	—	—	43.4	63.2	—	—	—	256	398	—	—	92	70	—	—	Calm	s b w	s w b w	s 58 w	0.0	4.8	2.0	2.52	4.11	Inap	...
6	728	781	896	.8092	54.2	62 0	49.2	54.78	+ 6.57	283	274	297	282	69	51	86	69	n w b w	n b w	n b w	n 20 w	5.6	11.6	7.2	7.24	7.48	...	...
7	969	952	894	.9362	41.1	51.9	42.8	46.07	— 1.78	216	278	247	249	84	73	91	81	n b e	s e b e	Calm	n 73 e	2.8	3.6	0.0	2.37	2.73	...	...
8	892	840	822	.8492	39.8	59.4	48.1	49.67	+ 2.22	220	359	294	295	91	72	89	84	Calm	s	Calm	s 32 e	0.0	2.2	0.0	0.58	0.76	...	...
9	853	798	801	.8152	45.2	70.1	55.3	56.72	+ 9.65	279	383	355	337	94	54	83	77	Calm	s	e b s	s 62 e	0.0	1.0	1.5	0.59	0.82	...	...
10	821	769	719	.7672	44.9	67.3	50.6	54.83	+ 8.17	287	346	253	314	97	53	70	76	n e b n	Calm	Calm	s 62 e	1.5	0.0	0.0	0 45	0.51	...	...
11	724	779	873	.7992	52.1	64.9	50.8	56.42	+10.17	291	242	281	281	76	40	77	65	s s w	n w	n	n 19 w	1.4	12.4	10.3	7.96	9.13	...	...
12	29.822	790	—	—	45.4	54.6	—	—	—	209	312	—	—	70	75	—	—	n n e	s e	e	s 79 e	1.0	4.5	0.8	0.86	1.08	0.115	...
13	616	635	806	.6960	51.0	53.9	40.6	48.07	+ 2.50	344	216	127	223	97	53	50	65	Calm	n w b n	n	s 20 e	0.0	21.8	16.8	12.49	13.54	Inap	...
14	956	979	30 080	30.0198	35.2	39.9	33.7	36.32	— 8.95	114	110	106	119	56	45	55	55	n b e	n n e	n b e	n 10 e	9.2	10.0	6.6	9.74	9.96	...	...
15	30.175	30.128	30.088	30.1325	28.4	43.4	31.6	35.17	— 9.68	110	163	144	140	70	59	80	69	n b e	s	Calm	n 43 w	6.7	2.4	0.0	0.22	2.50	...	...
16	30.052	29.951	29.900	29.9617	27.3	48.9	38.8	38.57	— 5.97	130	224	177	177	86	65	75	75	Calm	s w b s	n n w	s 83 w	0.0	7.8	4.8	1.49	3.48	...	...
17	29.888	29.823	705	.7905	37.0	51.3	46.7	44.90	+ 0.67	174	302	274	248	80	81	87	83	n	e n e	n b e	n 49 e	4.7	8.3	2.8	5.83	6.40	0.365	...
18	610	608	705	.6437	45.6	47.9	47.3	47.05	+ 3.02	288	289	290	291	95	89	90	91	n e	n n w	w n w	n 32 w	6.4	9.2	0.4	3.47	4.46	0.225	...
19	835	859	—	—	44.2	53.3	—	—	—	268	321	—	—	93	81	—	—	Calm	s w	Calm	s 60 w	0.0	3.0	0.0	0.72	0.77	0.010	...
20	952	891	913	.9170	37.5	53.8	40.4	44.05	+ 0.48	214	331	237	267	96	82	95	93	Calm	Calm	Calm	s 33 w	0.0	0.0	0.0	0.04	0.04	...	...
21	891	802	690	.7892	38.4	52.6	48.5	46.70	+ 3.45	217	326	295	283	94	84	88	89	Calm	Calm	Calm	n 66 w	0.0	0.0	0.0	0.13	0.14	...	...
22	607	537	553	.5610	54.2	59.3	52.8	55.17	+12.20	367	418	313	366	89	85	80	85	Calm	n	n n w	n 25 w	0.0	0.8	11.4	4.40	4.63	0.025	...
23	635	714	883	.7545	44.9	44.9	33.4	40 97	— 1.78	248	132	108	167	84	45	57	64	n b e	n n w	n b e	n 23 w	0.5	21.8	9.2	9.82	10.40	...	...
24	989	957	943	.9513	23.3	38.4	30.5	31.52	—10.98	107	124	134	121	83	54	79	69	n	s e	e b n	n 83 e	1.4	8.5	1.1	3.28	4.36	...	...
25	830	696	690	.7407	38.8	42.1	42.1	40.60	— 1.68	169	166	183	167	73	63	69	67	e b s	e s e	Calm	s 82 e	13.9	14.2	0.0	7.64	7.68	0.010	...
26	818	778	—	—	38.8	50.8	—	—	—	260	288	—	—	85	78	—	—	Calm	s b w	s b w	s 32 w	0.0	6.0	1.2	1.85	2.45	...	...
27	519	350	403	.4202	46.0	46.0	45.2	45.47	+ 3.68	279	292	270	281	90	95	90	93	s s w	e n e	w b s	s 54 w	4.0	2.0	19.0	4.38	7.39	0.105	...
28	355	324	451	.3838	37.3	45.9	40.7	41.90	+ 0.42	193	163	178	176	87	53	71	68	s w b w	w s w	w s w	s 73 w	4.0	21.5	14.5	15.12	15 17	...	...
29	523	466	234	.4048	41.5	47.4	47.0	45.45	+ 4.18	244	186	267	233	94	57	84	78	w s w	s w	e s e	s 43 w	8.5	10.0	4.6	9,33	11.45	0.020	...
30	274	288	345	.3023	42.0	39.4	34.5	38.22	— 2 73	247	116	157	166	94	48	78	72	s w	w b s	s w b w	s 76 w	12.6	21.0	12.0	13.99	14.17	...	Inap
31	329	384	464	.3970	31.2	35.0	35.1	34.13	— 6.62	154	127	119	132	88	62	58	68	w *b* s	w b n	s w b w	s 75 w	10.4	14.5	9.6	13.99	14.89	...	0.1
M	29.7145	29.6891	29.7132	29.7069	40.83	51.20	43.44	45.34	+ 0.30	.222	.242	.225	.231	.85	.63	.77	.75	....	....	....	....	3.84	8.68	4.76	......	6.07	0.875	0 1

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR OCTOBER.

Highest Barometer . . . . 30.200 at 8 a. m. on 15th } Monthly range=
Lowest Barometer . . . . 29.217 at midn't. on 29th } 0·983 inches.

Highest registered temperature . . . . 71°4 on p. m. of 9th } Monthly range=
Lowest registered temperature . . . . 23°0 on a. m. of 24th } 48°4

Mean maximum temperature . . 54°04 } Mean daily range = 18°82
Mean minimum temperature . . 35°22 }

Greatest daily range . . . . 28°5 from p. m. of 13th to a. m. of 14th.
Least daily range . . . . 6°4 from p. m. of 18th to a. m. of 19th.

Warmest day . . 9th ... Mean Temperature . . . 56°72 } Difference=25°20.
Coldest day . . . . 24th ... Mean Temperature . . . 31°52 }

Greatest intensity of Solar Radiation . . 88°4 on p. m. of 9th } Monthly range=
Lowest point of Terrestrial Radiation . 7°5 on a. m. of 24th } 80°9

Aurora observed on 3 nights, viz.: on the 4th, 8th and 23rd; possible to see Aurora on 19 nights; impossible to see Aurora on 12 nights.

Snowing on 2 days; depth, 0.1 inches; duration of fall, 1.5 hours.

Raining on 10 days; depth, 0.875 inches; duration of fall, 27.8 hours.

Mean of cloudiness=0.47; most cloudy hour observed, 4 p. m., mean=0.53: least cloudy hour observed, midnight; mean=0.40.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
1562.21	1187.47	703.87	2263.32

Resultant direction of the wind, N 76° W; Resultant Velocity, 2.15 miles per hour.

Mean velocity of the wind . . . . 6.07 miles per hour.
Maximum velocity . . . . 27.4 miles per hour, from 3 to 4 p.m. on 13th.

Most windy day . . . . 28th—Mean velocity, 15.17 miles per hour.
Least windy day . . . . 20th—Mean velocity, 0.04 do

Most windy hour . Noon to 1 p. m—Mean velocity, 9.82 do } Difference
Least windy hour 11 p. m. to midnight.—Mean velocity, 3.86 do } 5.96 miles.

1st to 2nd. Hoar Frost on these mornings at 6 a. m.

4th. Sheet Lightning, not accompanied by Thunder, during the Evening.

10th. Very dense ground Fog at 6 a. m.

" Small halo round the Moon at 10 p. m.

14th and 15th. Thin Ice on the water at 6 a. m.
19th to 22nd inclusive. Extraordinary and continuous dense Fog.
22nd. Sheet Lightning and distant Thunder 8 to 11 p. m.
30th. First Snow of the Season at 11 a. m.
31st. Snowing slightly most of the day.

This month was marked by an unusual scarcity of rain, the quantity that fell having been less than one-third of the average.
The Resultant direction of the Wind for October, from 1848 to 1856 inclusive, was N 63° W, and the Resultant velocity 1.35 miles per hour.

COMPARATIVE TABLE FOR OCTOBER.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	No. of dy's.	Inches.	No. of dy's.	Inches.	Resultant. Direction.	Resultant. Velocity.	Mean Velocity
	°	°	°	°	°					°		
1840	44.4	— 0.8	23.9	20.9	44.6	13	1.860	3	—	—	—	—
1841	41.6	— 3.6	58.3	20.3	38.0	6	1.360	2	—	—	—	0.41 lbs.
1842	45.1	— 0.1	68.5	30.0	38 5	8	5.175	0	—	—	—	0.35 "
1843	41.8	— 3.4	65.7	24.5	41.2	12	3.790	4	2.5	—	—	0.54 "
1844	43.3	— 1.9	69.6	17.8	51.8	7	Impft	4	12.0	—	—	0.43 "
1845	46.4	+ 1.2	62.7	20.0	42.7	11	1.760	1	Inapp	—	—	0.26 "
1846	44.6	— 0.6	69.7	20.7	49.0	14	4.180	2	Inapp	—	—	0.44 "
1847	44.0	— 1.2	65.0	20.3	44.7	13	4.390	2	Inapp	—	—	0.19 "
1848	46.3	+ 1.1	62.2	26.4	35.8	11	1.550	0	0.0	N 54 W	1.24	4·60 mls.
1849	45.3	+ 0.1	59.2	25.5	33.7	13	5.965	1	Inapp	N 12 W	1.27	4.76 "
1850	45.4	+ 0.2	66.6	24.8	41.8	10	2.085	0	0.0	N 66 W	1.10	5.30 "
1851	47.4	+ 2.2	66.1	25.0	41.1	10	1.680	2	0.3	S 72 W	1.06	4.39 "
1852	48.0	+ 2.8	70.7	29.8	40.9	12	5.280	0	0.0	N 5 E	1.19	4.47 "
1853	44.4	— 0.8	61.7	25.5	39.2	10	0.875	2	Inapp	S 87 W	1.52	4.72 "
1854	49.5	+ 4.3	74.2	29.8	44.4	15	1.495	3	Inapp	N 25 E	1.18	4.60 "
1855	45.4	+ 0.2	64.3	28.0	36.3	14	2.485	5	0.8	N 82 W	4.91	9.88 "
1856	45.3	+ 0.1	70.1	23.3	46.8	10	0.875	2	0.1	N 76 W	2.15	6.07 "
Mean	45.19	...	66.24	24.45	41.79	11.1	2.800	1.9	1.1	—	—	5.42

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY TORONTO, CANADA WEST—NOVEMBER, 1856.

Latitude—43 deg. 39.4 min. North. Longitude—79 deg. 21 min. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Mean Temp. +or— of the Av'age.	Tens. of Vapour.				Humidity of Air.			
	6 A.M.	2 P.M.	10 P.M.	MEAN	6 A.M	2 P.M	10PM	ME'N		6 A.M	2 P.M	10 P.M	M'N	6 A.M	2 P.M	10 P.M	M'N
					°	°	°	°	°								
1	29.227	29.067	29.279	29.1908	39.5	53.1	41.0	44.05	+ 3.58	.146	.225	.215	.200	.60	.56	.84	.69
2	.372	.427	—	—	42.7	51.0	—	—	—	.223	.269	—	—	.82	.73	—	—
3	.623	.445	.408	.4880	48.8	49.5	49.9	48.98	+ 8.98	.321	.298	.337	.314	.94	.85	.97	.92
4	.291	28.902	.292	.1780	51.0	56.4	34.8	46.02	+ 6.25	.353	.344	.115	.256	.96	.76	.55	.76
5	.591	29.802	30.004	.8223	26.4	32.5	25.1	27.92	—11.57	.106	.090	.094	.098	.72	.49	.67	.64
6	30.041	.940	29.814	.9255	22.8	40.3	39.9	35.43	— 3.73	.106	.148	.196	.157	.84	.59	.81	.75
7	29.772	.725	.613	.6943	42.7	49.3	50.3	47.72	+ 8.72	.240	.242	.266	.251	.89	.70	.73	.77
8	.283	.684	.929	.6308	50.6	38.8	28.4	39.32	+ 0.63	.338	.141	.136	.204	.93	.60	.87	.78
9	.922	.878	—	—	29.6	33.0	—	—	—	.125	.131	—	—	.76	.69	—	—
10	.914	.893	.823	.8738	24.8	35.9	37.3	33.15	— 4.93	.108	.120	.156	.133	.79	.57	.71	.70
11	.755	.761	.823	.7813	39.5	43.7	40.2	40.35	+ 2.57	.204	.171	.176	.187	.85	.61	.72	.76
12	.851	.833	882	.8605	36.7	43.6	36.9	38.70	+ 1.20	.178	.158	.148	.171	.82	.55	.68	.73
13	.871	.788	.740	.7892	33.0	38.8	36.1	36.03	— 1.15	.175	.216	.184	.187	.94	.93	.87	.89
14	.656	.691	.795	.7195	34.5	38.4	34.8	35.67	— 1.23	.194	.167	.169	.171	.98	.72	.84	.83
15	.763	.588	.372	.5577	24.1	36.6	39.0	33.70	— 2.80	.115	.136	.174	.153	.86	.63	.74	.78
16	.257	.312	—	—	39.1	41.6	—	—	—	.221	.200	—	—	.94	.76	—	—
17	.392	.473	.635	.5120	27.3	32.3	30.2	29.77	— 6.03	.126	.116	.145	.133	.85	.64	.86	.81
18	.729	.757	.807	.7643	30.9	35.6	32.0	32.95	— 2.53	.158	.144	.141	.143	.93	.69	.78	.76
19	.852	.858	.936	.8885	27.3	38.1	29.5	32.03	— 3.05	.131	.139	.138	.136	.86	.61	.84	.76
20	.991	.980	.957	.9717	31.7	36.5	35.9	34.85	+ 0.05	.149	.157	.164	.160	.83	.73	.78	.79
21	.807	.554	.227	.5152	37.3	40.3	46.3	41.55	+ 7.17	.195	.195	.266	.219	.88	.79	.86	.83
22	.437	.707	.860	.6933	44.9	42.0	33.8	39.68	+ 5.60	.252	.156	.147	.171	.85	.59	.75	.70
23	.897	.690	—	—	32.0	40.9	—	—	—	.153	.212	—	—	.85	.84	—	—
24	.594	.695	.790	.7050	34.8	45.4	40.4	39.52	+ 6.25	.185	.218	.185	.192	.92	.72	.74	.80
25	.763	.464	.245	.4720	39.5	39.8	41.3	40.58	+ 7.62	.208	.214	.247	.228	.87	.88	.97	.91
26	.324	.503	.631	.5048	45.2	44.5	38.8	41.87	+ 9.30	.211	.161	.224	.194	.71	.56	.95	.75
27	.594	.565	.598	.5900	37.7	40.2	29.3	35.20	+ 3.02	.169	.129	.126	.136	.75	.51	.78	.67
28	.626	.592	.512	.5740	29.4	33.9	35.2	33.13	+ 1.25	.145	.146	.158	.148	.89	.74	.78	.78
29	.279	.260	.495	.3485	29.1	26.1	26.9	26.57	— 4.93	.142	.130	.131	.130	.88	.89	.88	.88
30	.630	.802	—	—	27.8	34.8	—	—	—	.129	.157	—	—	.84	.77	—	—
M	29.6410	29.6211	29.6587	29.6421	35.58	40.46	36.54	37.39	+ 1.24	.186	.174	.178	.179	.85	.68	.80	.78

Day.	Direction of Wind.			Mean Direction.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.		6 A.M	2 P.M	10PM	Re-sul't.	ME'N		
				°							
1	S S W	W S W	W	S 54 W	19.7	22.1	3.0	9.42	10.75	...	...
2	N b W	S	S W	S 40 W	2.2	5.1	0.6	2.20	3.74	0.175	...
3	E b N	E	Calm.	N 88 E	7.8	8.0	0.0	3.88	3.93	0.205	...
4	E b S	S S W	W N W	S 78 W	4.4	20.0	31.5	14.96	20.93	...	...
5	W	N W	W N W	N 65 W	18.6	16.2	3.0	10.49	10.95	...	...
6	Calm.	S b W	S b E	S 5 W	0.0	19.6	6.0	8.36	8.70	...	...
7	S b E	S	S b E	S 1 E	7.0	9 0	6.2	6.17	6.59	0.180	...
8	S b E	W	N W b N	S 86 W	12.2	30.6	2.0	10.77	13.85	0.045	Inap
9	N W b N	W	N W b W	N 76 W	5.4	7.4	9.5	5.33	5.64	...	...
10	N W b W	S E b S	S S E	S 33 E	1.4	8.0	6.5	5.05	6.37	...	...
11	S S W	S S W	W b N	S 72 W	11.2	4.5	5.1	2.42	3.74	...	...
12	N W b N	W N W	W b N	N 69 W	3.5	12.0	9.0	8.82	9.05	...	0.1
13	W S W	S b E	N E b E	N 88 E	1.1	0.8	2.8	3.00	5.48	0.290	0.5
14	N E	N	N b W	N 6 E	12.3	13.5	8.5	9.74	10.78	0.055	0.5
15	N W b N	S S W	S	S 25 W	5.2	9.0	12.5	6.61	8.22	0.015	...
16	S W	W b S	W N W	S 89 W	9.0	19.0	9.5	9.73	10.58	...	0.6
17	N W b N	W	N W b W	N 65 W	9.0	16.2	10.0	10.91	11.08	...	0.1
18	W N W	N W b W	W	N 74 W	16.5	17.2	3.6	8.73	9.05	...	...
19	W b S	W	Calm.	N 88 W	1.9	3.3	0.0	0.12	1.33	...	...
20	Calm.	E	E	N 80 E	0.0	5.0	5.8	5.73	5.79	...	...
21	E b N	E	E	S 55 E	14.8	15.6	4.0	6.83	16.54	0.195	...
22	S W	W S W	Calm.	S 62 W	25.0	17.2	0.0	10.07	10.09	...	...
23	Calm.	E N E	N E b E	N 67 E	0.0	8.3	1.5	4.89	5.33	...	...
24	Calm.	N N W	Calm.	N 10 E	0.0	4.0	0.0	0.78	1.07	...	...
25	E b N	E b N	E b N	N 83 E	9.0	20.6	3.0	9.46	13.53	0.215	...
26	W b S	W	W	S 80 W	20.7	26.2	3.5	13.09	13.18	Inap	...
27	W b S	W b N	W b S	S 80 W	10.0	20.2	3.6	10.16	10.29	...	...
28	W b N	E b N	E	N 74 E	3.0	8.3	12.0	7.69	9.17	...	3.5
29	N E b E	N N W	N N W	N 1 W	20.2	11.0	1.0	6.02	8.19	...	4.2
30	W b S	W N W	W N W	N 72 W	8.5	15.8	5.0	7.32	8.71	...	Inap
M					8.65	13.12	5.62		8.75	1.375	9.5

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR NOVEMBER.

Highest Barometer .... 30.048 at 8 a. m., on 6th } Monthly range=
Lowest Barometer .... 28.902 at 2 p. m., on 4th } 1.146 inches.

Highest registered temperature......... 56°4 at p. m., on 4th } Monthly range=
Lowest registered temperature......... 18°8 at a. m., on 6th } 37°6

Mean maximum Thermometer......... 43°02 } Mean daily range = 14°27
Mean minimum Thermometer......... 28°74 }

Greatest daily range .... 32°4 from p. m. of 4th to a. m. of 5th.
Least daily range.............................. 6°1 from a. m. of 20th to a. m. of 21st.

Warmest day......... 3rd ... Mean temperature......... 48°98 } Difference = 22°41.
Coldest day............ 29th ... Mean temperature......... 26°57 }

Greatest intensity of Solar Radiation .... 67°5 on p. m. 4th } Monthly range=
Lowest point of Terrestrial Radiation .... 5°8 on a. m. 6th } 61°7

Auroral Light observed on 1 night, viz., 4th; possible to see Aurora on 10 nights; impossible to see aurora on 20 nights.

Snowing on 9 days.—depth 9.5 inches—snowing 30·2 hours.
Raining on 10 days,—depth 1.375 inches—raining 42.3 hours.

Mean of cloudiness =0.81; most cloudy hour observed, 8 a. m., mean =0.91; least cloudy hour observed, 10 p. m., mean, =0.74.

Sum f the Atmospheric Current, in miles, resolved into the four Cardinal directions.

North.	South.	East.	West.
1296.20	1491.66	1428.63	3539.50

Resultant direction of the wind, S 85° W.; Resultant Velocity 2.95 miles per hour.
Mean velocity of the wind......... 8.75 miles per hour.
Maximum velocity .... 40.8 miles per hour, from 4 to 5 p. m. on 4th.
Most windy day......................... 4th...Mean velocity 20.93 miles per hour.
Least windy day .... 24th...Mean velocity 1.07 ditto.
Most windy hour ... 2 to 3 p. m............Mean velocity 13.29 ditto.
Least windy hour, Midnight to 1 a.m. ...Mean velocity 5.70 ditto.
Mean diurnal variation = 7.59 miles.

4th—Dense Fog, 6 to 8 a. m.
4th—Auroral Light at Midnight.
6th—Halo round the Moon, 7 to 9 p. m.
8th—Zodaiacal Light, very bright, 5.30 to 6 p. m.
10th—Halo round the Moon, 8 to 9 p. m.
15th—Halo round the Sun, and faint Parhelion at 2 p. m.
25th—Dense Fog at Midnight.
30th—First Sleighing in Toronto this Season.

Rain—The scarcity shown by the record of October, continued to a great extent through November, the amount that fell in November having been less than half the average.

Wind—The mean velocity of the wind was 2.23 above the average, and was but once exceeded during the last nine years.

The Resultant Direction of the wind for November of the last nine years was N 70° W, and the resultant velocity 1.84 miles per hour.

COMPARATIVE TABLE FOR NOVEMBER.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range.	Days.	Inch's.	Days.	Inch's.	Resultant. Direction.	Resultant. V'y.	Mean Force or Velocity.
1840	° 35.9	° —0.9	° 54.4	° 20.5	° 33.9	5	1.220	8	...	...	...	....
1841	35.0	—1.8	63.2	7.6	55.6	8	2.450	5	...	...	...	0.91 lb
1842	33.3	—3.5	50.6	7.6	43.0	9	5.310	10	...	...	...	1.22 "
1843	33.5	—3.3	51.2	14.4	36.8	10	4.765	7	1.2	...	...	0.59 "
1844	34.9	—1.9	49.8	12.0	37.8	8	imper	4	8.0	...	...	0.48 "
1845	36.8	0.0	58.8	7.6	51.2	7	1.105	4	5.0	...	...	0.53 "
1846	41.3	+4.5	55.5	18.2	37.3	12	5.805	2	0.4	...	...	0.64 "
1847	38.6	+1.8	53.2	7.8	50.4	14	3.155	3	Inapp	...	...	0.36 "
1848	34.5	—2.3	49.3	16.5	32.8	9	2.020	3	1.4	N 81° W	1.81	4.81 miles.
1849	42.6	+5.8	56.7	28.4	28.3	10	2.815	2	1.0	N 40° W	1.55	4.78 "
1850	38.8	+2.0	62.3	18.1	44.2	7	2.955	1	Inapp	N 42° W	1.43	5.27 "
1851	32.9	—3.9	50.1	16.5	33.6	5	3.885	6	6.7	N 50° W	1.25	4.70 "
1852	36.0	—0.8	50.4	18.7	31.7	7	1.775	3	2.0	N 59° W	1.53	6.50 "
1853	38.7	+1.9	54.1	14.4	39.7	15	2.425	6	2.7	N 1° E	0.56	5.52 "
1854	36.8	0.0	54.9	15.1	39.8	13	1.115	4	1.3	S 88° W	3.72	7.58 "
1855	38.6	+1.8	54.1	18.7	35.4	8	4.590	6	3.0	N 66° W	3.18	10.81 "
1856	37.4	+0.6	56.4	22.8	33.6	10	1.375	9	9.5	S 85° W	2.95	8.75 "
M	36.80	...	54.71	15.58	39.12	9.2	2.923	4.9	3.0			6.52 miles.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—OCTOBER, 1856.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL. D.

Latitude—45 deg. 32 min. North. Longitude—73 deg, 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32° Fahr.			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Mean direction of Wind.	Velocity in miles per hour.			Snow in Inches.	Rain in Inches.	WEATHER, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.		6 A.M.	2 P.M.	10 P.M.			6 A.M.	2 P.M.	10 P.M.
1	29.351	29.356	29.454	48.6	57.2	46.0	.348	.447	.273	.96	.93	.82	w s w	w s w	w s w	w 23 s	9.06	5.71	5.81	...	2.698	Rain.	Cir. Str. 8.	Cir. Str. 8.
2	.508	.548	.704	43.6	49.8	47.0	263	270	291	80	74	86	s w	s w by s	w s w	w 45 s	16.40	12.70	6.71	...	Inp	Cir. Str. 10.	Cir. Str. 8.	Do. 8.
3	.756	.790	.904	43.6	59.6	40.7	272	358	246	91	70	91	w by s	w N w	N W b N	w 30 s	0.62	5.56	3.01	...	...	Clear.	Cir. Cm. Str. 4.	Clear.
4	.980	.992	30.093	36.3	64.0	43.0	230	321	252	96	54	85	w N w	w N w	s by w	w 4 N	0.00	3.08	0.00	...	...	Str. 8.	Cum. 2.	Clear. Aur. Bor.
5	.915	.780	29.798	42.7	68.1	58.5	242	523	462	85	76	93	s E	s by E	w s w	s 11 E	0.36	0.00	0.00	...	0.050	Clear.	Cir. Cum. Str. 6	Str. 10.
6	.768	.877	.981	56.2	66.4	47.2	458	464	313	98	72	93	w s w	w s w	N by E	s 33 w	0.80	10.00	4.55	...	0.330	Rain.	Cir. Str. 7.	Cir. Str. 4.
7	30.184	30.141	30.060	48.6	68.4	44.3	312	513	268	89	72	85	w	w	s by E	w 11 N	0.11	1.16	0.90	...	...	Clear.	Cir. Str. 2.	Cir. Str. 4.
8	29.916	29.890	29.904	43.0	67.2	54.0	272	455	351	91	69	83	s by w	s w by s	s w	w 34 s	0.00	4.85	0.00	...	...	Str. 2.	Str. 2.	Clear.
9	.912	.851	.996	52.3	74.9	65.6	349	617	499	87	74	80	w by s	w by s	w by s	w 22 s	8 00	0.00	3.81	...	...	Cir. Str. 2.	Clear.	Do.
10	.930	.814	.839	54.8	80.6	61.0	373	617	441	87	61	81	w s w	w s w	s w	w 40 s	5.05	6.17	4.97	...	...	Cir. Cm. St. 4.	Do.	Do.
11	.713	.907	30.007	53.4	69.9	49.0	361	461	200	87	65	81	w by s	w by s	N by w	w 23 N	9.31	11.11	2.92	...	...	Clear.	Do.	Do.
12	.970	.834	29.756	34.3	63.0	48.9	194	366	302	91	64	86	N E	w s w	w s w	w 22 s	0.45	3.21	4.27	...	...	Do.	Do.	Do. Eclip. of M.
13	.650	.704	.847	42.8	67 9	40.6	272	480	205	91	72	79	w by N	w by s	N w	w 2 N	5.47	4.73	5.72	...	...	Do.	Cir. Str. 8.	Cir. 2.
14	.943	30.022	30.194	31.9	41.0	28.1	167	189	144	84	70	83	N by w	N by w	N w	w 40 N	10.40	6.85	6.55	...	...	Do.	Clear.	Clear.
15	30.254	.203	.121	24.9	47.4	34.6	117	234	189	75	69	86	N W b W	w by s	s w	w 34 s	0.90	9.90	4.31	...	...	Do.	Do.	Do.
16	.044	.025	.089	32.0	54.1	40.2	164	283	196	81	66	75	s w	w b s	w	w 33 s	0.22	3.86	5.08	...	...	Do.	Do.	Do.
17	.056	.051	30.043	32.4	56.6	41.1	175	363	250	87	79	87	s E	s E	s E	E 6° N	0.22	1.02	2.22	...	...	Do.	Do.	Do.
18	29.898	29.850	29.837	40.0	44.6	44.0	233	282	288	87	91	92	E N E	N E by E	N E b N	E 34 N	5.70	8.82	9.33	...	0.466	Cir. Str. 10	Cir. Str. 10.	Cir. Str. 10.
19	.854	.900	.999	44.3	51.3	42.8	283	337	272	92	87	90	w N w	w by s	w s w	w 12 s	2.20	6.22	7.70	...	...	Do. 4.	Do. 6.	Clear.
20	30.046	30.024	30.043	40.7	50.1	38.2	245	326	226	92	87	91	s w by w	w by s	s w	w 33 s	0.02	2.01	0.12	...	...	Fog.	Fog.	Dense Fog.
21	29.961	29.910	29.901	41.0	56.4	50.4	250	385	349	87	84	92	s w	w	N w	w 4 s	1.70	2.07	0 00	...	Inp	Fog.	Fog.	Rain.
22	.736	.654	.657	43.0	44.9	42.3	274	232	263	93	64	90	N E	N E by N	s w b w	N 34 E	11.08	5.95	2.23	...	0.533	Rain.	Cir. Str. 10.	Cir. Str. 10.
23	.654	.714	.870	38.8	42.7	30.1	207	243	145	84	83	79	N w	N w	N w b w	N 40 w	5.00	17.30	9.30	...	...	Clear.	Clear.	Clr. Aur. Bor.
24	.987	.953	30.105	23.6	43.2	29.6	106	184	152	73	63	85	N w	N by E	s w	N 23 w	7.71	8.17	3.22	...	...	Do.	Do.	Do.
25	30.052	30.014	29.945	24.5	47.9	32.3	115	252	170	76	74	84	s w	s w	s s w	w 35 s	0.10	0.98	1.31	...	...	Do.	Do.	Do.
26	29.913	29.857	.902	36.8	53.9	38.0	210	255	190	90	61	78	N w	w	w s w	w 12 s	0.00	0.41	2 03	...	...	Do.	Cir. Cum. Str. 4	Do.
27	.843	.549	.807	28.9	45.0	42.0	170	272	250	91	86	87	s s w	s	E by s	s 12 E	1.27	1.62	0.89	...	0.153	Cir. Str. 4.	Cir. Str. 10.	Cir. Str. 10.
28	.464	.327	.310	41.6	50.6	42.5	235	246	232	85	65	82	w by s	w	w	w 5° s	0.82	6.83	11.21	...	0.500	Do. 6.	Do. 9.	Do. 2.
29	.481	.559	.604	35.3	43.6	36.3	155	199	192	70	68	83	w N w	N w b w	s by w	w 33 N	28.01	14.63	7.01	...	...	Do. 10.	Clear.	Do. 10.
30	.336	.338	.394	40.2	41.5	37.4	227	254	199	85	92	83	s s w	w N w	w N w	w 23 N	5.76	5.62	7.71	...	0.490	Rain.	Do.	Clear.
31	.407	.307	.441	28.4	39.8	29.8	144	184	152	83	73	85	w N w	w N w	w N w	w 23 N	7.90	9.22	12.75		...	Clear.	Cir. Str. 4.	Do.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—NOVEMBER, 1856.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Velocity in miles per hour.			Mean direction of Wind.	Rain in Inches.	Snow in Inches.	WEATHER, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 PM	6 A.M.	2 P.M.	10 P.M	6 A.M.	2 P.M.	10 PM				6 A.M.	2 P.M.	10 P.M.
1	29.414	29.233	29.292	33.6	34.0	42.2	.204	.206	.234	.92	.92	.83	W S W	SW b W	W	14.00	10.05	7.00	W °3 N	0.033	Inp	Cir. Str. 8.	Cir. Str. 10.	Cir. Str. 10.
2	.582	.600	.756	40.6	47.6	45.6	.248	.291	.292	.90	.86	.92	W S W	SW by S	SWb W	12.75	0.22	0.45	W 4 S	0.120	...	Nimb. 10.	Nimb. 10.	C. Str. 6.
3	.855	.784	.677	43.4	45.0	43.6	.272	.296	.279	.91	.90	.9	SE by S	E	NE b E	1.00	2.62	9.70	E 33 N	0.216	...	Cir. Str. 10.	Cir. Str. 10.	Cir. Str. 10.
4	.482	.114	.057	42.5	56.1	54.4	.284	.408	.418	.92	.88	.92	E N E	E N E.	W	3.80	5.71	4.04	E 33 N	0.090	...	Do. 10.	Do. 10.	Rain.
5	.377	.685	.956	26.5	31.0	24.3	.108	.171	.115	.66	.89	.76	W by N	N N W	N W	25.43	33.37	21.06	W 23 N	0.110	...	Do. 10.	Do. 4.	Clr. Aur. Bor.
6	30.238	.220	30.221	17.1	34.9	26.1	.696	.203	.129	.83	.90	.80	W S W	SW bys	S b W	10.03	6.04	4.51	W 40 S	...	...	Clear.	Do. 8.	Clear.
7	.104	.106	30.126	40.7	49.0	40.7	.210	.290	.210	.79	.80	.81	W b S	W b S	S b E	4.66	6.21	8.10	S 11 W	...	...	Cir. Str. 6.	C. St. 4.	Cir. Str. 10.
8	29.886	29.670	29.970	46.0	62.0	37.2	.282	.421	.218	.86	.75	.91	S by W	S	W	11.06	20.11	30.50	W 33 N	0.360	...	Do. 4.	Cul. Str. 9.	Clear.
9	30.050	30.022	30.008	25.6	32.2	24.0	.123	.153	.121	.81	.76	.90	S E	W	NW b W	8 72	1.37	8.42	W 33 N	...	...	Do. 4.	Do. 9.	Do.
10	.127	.227	.104	16.7	31.1	20.0	.084	.141	.089	.73	.70	.68	NE by N	NWbW	S S W	1.73	2.37	0.40	W 40 N	...	...	Clear.	Clear.	Do.
11	.078	30.035	.009	17.1	53.7	26.9	.184	.153	.129	.73	.74	.80	N W	S E	E N E	0.80	1.07	0.00	E 23 N	...	...	Do.	Do.	Cir. Str. 10.
12	29.967	29.948	29.950	27.6	34.5	31.3	.119	.186	.168	.71	.83	.86	E N E	W S W	W by N	—	—	0.15	W 33 S	...	...	Cir. Str. 6.	C. Str. 9.	Do. 2.
13	.990	.943	30.004	28.9	43 5	30.1	.144	.194	.160	.83	.74	.86	N E	SWbW	S S E	0.21	2.07	—	W 23 N	...	...	Cir. Str. 2.	Do. 6.	Do. 10.
14	.996	29.982	29.940	26.5	31.6	22.9	.147	.152	.115	.90	.78	.82	NW b W	E N E	E N E	4.80	6.23	6.60	E 23 N	...	...	Cir. Str. 10.	Str. 4.	Light Cum. 1.
15	.889	.710	.664	24.0	32.3	21.0	.086	.187	.116	.82	.81	.84	E N E	W N W	W by N	0.33	6.05	5.97	W 15 N	...	...	Clear.	Clear.	Clear.
16	.516	.465	.431	23.1	44.3	31.5	.136	.251	191	.90	.80	.90	W N W	S by E	NE b N	0.16	0.80	1.78	S 23 W	...	0.40	C. Str. 10.	C. Str. 6.	Cir. Str. 10.
17	.447	.492	.591	20.0	26.7	22.5	.107	.146	.120	.82	.81	.82	S W	W N W	W N W	6.15	4.43	6.96	W 23 N	...	Inp	Cir. Str. 2.	Do. 10.	Do. 10.
18	.638	29.760	.870	23.1	34.1	26.3	.106	.178	.129	.74	.83	.80	W N W	W N W	W N W	13.10	11.93	11.90	W 23 N	...	...	Cul. Str. 4.	Do. 9.	Do. 10.
19	.917	.904	.099	29.1	31.8	21.1	.152	.260	.117	.85	.88	.80	W N W	W N W	W	8.09	5.21	0.60	W 12 N	...	...	Str. 1.	Clear.	Clr. Zod. Lgt.
20	.156	.171	.176	20.0	27.0	17.7	.078	.137	.088	.60	.82	.73	W	S W	S W	0.46	0.47	2.80	W 23 S	...	...	Str. 10.	C. Str. 4.	Do. Aur. Bor.
21	.157	.052	.872	20.1	25.0	21.0	.078	.133	.108	.70	.79	.77	S S W	E N E	E N E	2.22	1.14	8.75	E 23 N	...	...	Cir. Str. 10.	Do. 10.	Cir. Str. 10.
22	.690	.740	.914	38.5	46.0	39.2	.226	.254	.199	.89	.70	.76	S	W S W	W S W	13.25	7.21	9.67	S 23 W	1.860	...	Rain.	Do. 8.	Do. 6.
23	30.042	.991	.892	33.0	42.1	35.1	.187	.208	.203	.90	.73	.91	S W	N W	S E	3.26	9.81	1.97	W 34 S	...	...	Clear.	Do. 8.	Do. 10.
24	29.744	.796	.951	33.7	39.1	34.1	.195	.229	.264	.90	.85	.94	N E	N E	E by N	5.71	5.52	0.16	E 33 N	...	...	Cir. Str. 6.	Do. 9.	Do. 10.
25	30.105	30.009	.840	35.3	35.9	32.0	.187	.170	.174	.90	.79	.89	E S E	NE by E	NE b E	0.27	4.92	6.10	E 33 N	...	...	Do. 6.	Do. 9.	Snow.
26	29.831	29.385	.673	33.1	39.0	33.0	.187	.214	.199	.90	.84	.91	N E	W N W	N W	10.60	4.03	8.75	W 20 N	3.910	1.30	Rain.	Do. 8.	C. Str. 10.
27	.694	.597	.654	46.8	30.1	33.8	.177	.187	.112	.95	.87	.67	NW b W	SW by S	N W	19.16	0.41	10.45	W 26 N	...	Inp	Cir. Str. 4.	Str. 10.	Clear.
28	.719	.791	29.864	79.1	20.0	23.0	.107	.119	.085	.82	.81	.88	N N W	N W	N by E	10.81	4.22	5.66	W 43 N	...	...	Clear.	Clear.	Do.
29	.672	.462	.484	54.2	12.3	15.7	.090	.071	.091	.91	.88	.87	NE by E	NE by E	W b S	6.00	8.20	7.90	E 33 N	...	3.00	Cir. Str. 10.	Cir. Str. 10	Snow.
30	.659	.714	.987	78.6	13.3	23.5	.677	.108	.083	.79	.72	.78	W by S	W N W	W by N	12.98	5.27	13.30	W 33 N	...	0.30	Clear.	Do. 6.	Cir. Str. 10.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR OCTOBER.

Barometer	Highest the 15th day	30.254
	Lowest the 28th day	29.310
	Monthly Mean	29.833
	Monthly Range	.944
Thermometer	Highest the 10th day	86°6
	Lowest the 25th day	20°6
	Monthly Mean	46°04
	Monthly Range	66°00

Greatest Intensity of the Suns Ray's .... 99°4

Lowest Point of Terrestrial Radiation .... 18°9

Mean of Humidity .... .809

Amount of Evaporation .... 2.17 inches

Rain fell on 10 days, amounting to 5.220 inches; it was raining 50 hours and 5 minutes.

Most prevalent wind, W S W. Least prevalent wind, E by S.

Most windy day, the 29th day; mean miles per hour, 16.55.

Least windy day, the 5th day, mean miles per hour, 0.23

Most windy hour, from 10 to 11, A. M., 29th day; velocity 31.00 miles.

There were 226 hours and 45 minutes calm.

There were 9 cloudless days in the month.

Total amount of miles of wind, 3732.10 miles, which being resolved into the Four Cardina Points, gives N 843 miles, S 371 miles, W 2270.10 miles, and E 248 miles.

Aurora Borealis visible on 5 nights.

Eclipse of the Moon on the 13th day visible.

The electric state of the atmosphere has been marked by moderate intensity.

Ozone was in moderate quantity.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR NOVEMBER.

Barometer	Highest, the 6th day	30.238
	Lowest, the 4th day	29.057
	Monthly Mean	29.820
	Monthly Range	1.171
Thermometer	Highest, the 8th day	62°.1
	Lowest, the 29th day	12°.1
	Monthly Mean	30°.40
	Monthly Range	50°.0

Greatest intensity of the Sun's Rays .... 89°.7

Lowest point of Terrestial Radiation .... 11°.6

Mean of Humidity .... .835

Rain fell on 8 days, amounting to 6.999 inches; it was raining 31 hours.

Snow fell on 7 days, amounting to 5 inches; it was snowing 19 hours 30 minutes.

Most prevalent Wind was WNW—.1064 miles.

Least prevalent Wind was NNE—.1 mile.

Most windy day, the 5th; mean miles per hour, 26.62.

Least windy day, the 12th; mean miles per hour, 0.05.

Most windy hour from 3 to 4 a. m., on the 8th, 36.40 miles.

There were 149 hours calm during the month.

There were 3 days cloudless.

The whole distance traversed by the wind was 4614 miles; resolved into the Four Cardinal Points, gives N 653; S 650; W 2386; E 975 miles.

Aurora Boreais visible on 2 nights.

The Zodiacal Light first seen on the 19th day, and was very bright on the 20th day.

A Rainbow was visible on the morning of the 7th, at 7.30 which was followed by Rain.

Snow Birds first seen on the 26th day.

The electrical state of the Atmosphere has been marked by very moderate intensity.

Ozone was in moderate quantity.

MEAN RESULTS OF METEOROLOGICAL OBSERVATIONS AT HAMILTON, C. W., FOR THE YEAR 1856.

1856.	THERMOMETER.					BAROMETER.			Days.			YEARS.
MONTHS.	Mean at 9 A. M.	Mean at 9 P. M.	Mean of both.	Highest.	Lowest.	Mean height.	Highest.	Lowest.	Rainy.	Slight Showers.	Dry.	Mean Temperature of.
	°	°	°	°								°
January	15.32	16.9	16.11	42	—16	29.639	30.23	29.15	4	7	20	1846...50.215
February	15.00	18.00	17.50	42	—16	.47	.00	28.70	2	7	20	7...48 163
March	24.03	24.55	24.29	45	—10	.558	.00	.96	4	7	20	8...49.295
April	40.86	44.96	44.41	78	21	.615	.00	29.14	4	7	19	9...48.105
May	65.1	53.22	34.16	90	28	.628	29 95	.22	7	5	19	50...48.732
June	67.5	54.4	65.95	94	46	.6175	.87	.35	4	7	19	51...48.756
July	75.742	74.806	75.274	98	52	.680	.91	.37	0	5	20	2...48.248
August	69.1	67.9	68.5	91	48	.612	29.93	.25	2	7	22	3...49.474
September	60.833	60.4	60.616	86	41	.656	30.00	.20	5	7	18	4...49.013
October	47.7	48 9	48.3	79	28	.7292	.14	.25	1	4	26	5...47.316
November	39.9	39.7	39.8	66	26	.632	29.97	.10	5	8	17	
December	25.1	24.4	24.75	45	—10	.645	30.35	28.63	5	8	18	Mn. 43.73
Mean Temperature of year			44.888			29.6242			43	79	244	

REGISTER, THERMOMETER, BAROMETER. &c.; HAMILTON, 1856.

DATE.	THERMOM. 9 A.M.	THERMOM. 9 P.M.	BAROM. 9 A.M.	BAROM. 9 P.M.	WEATHER.
	°	°			
December 1	31	27	29.80	29.70	Partly cloudy, some snow A. M.
2	32	32	.63	.25	Cloudy, snowing heavily at night, stormy.
3	36	28	28.68	.02	Partly cloudy, snowing A. M., sleighing.
4	29	30	29.50	.70	Do. do.
5	30	23	.75	.83	Fair and clear.
6	23	22	.80	.81	Do. do.
7	27	24	.80	.76	Partly cloudy.
8	27	29	.81	.90	Do. do., a little snow in the morning.
9	28	25	30.00	30.09	Fair and clear.
10	28	28	29.96	29.70	Do. do.
11	38	40	.20	.20	Rain, sleighing gone.
12	33	34	.45	.62	Partly cloudy.
13	34	34	.85	.60	Do. do., some snow at night.
14	36	26	28.63	28.90	Rainy A. M., snowing P. M., stormy.
15	22	23	29.52	29.70	Partly cloudy, sleighing.
16	21	21	.70	.68	Do. do.
17	15	10	30.60	30.13	Do. do.
18	—2	6	.35	.33	Do. do. a little snow P. M.
19	13	28	.05	29.55	Mostly cloudy, some rain at night forming ice.
20	42	18	29.25	.55	Cloudy, rainy A. M.
21	17	18	.80	.70	Fair and clear.
22	20	17	.40	.52	Mostly cloudy, snowing A. M.
23	13	13	.72	.80	Partly cloudy.
24	15	12	.65	.50	Do. do.
25	16	23	.45	.53	Do. do.
26	25	30	.63	.72	Do. do.
27	23	25	.82	.75	Cloudy.
28	30	32	.40	.45	Do., drizzling rain forming ice.
29	28	26	.55	.65	Mostly cloudy.
30	25	25	.71	.70	Do. do., a little snow at night.
31	23	27	.85	.90	Fair and clear.
Means	25.1	24.4	29.638	29.652	

Mean Temperature of the Month	24.75°
Highest	45°
Lowest	4°
Average of ten preceding years	30.76°

TO THE READER.

"So numerous a body as the Canadian Institute now is, ought to include a much greater number of working members; and the Council are led to believe that their apparent supineness arises, in part at least, from the mistaken idea that communications can only be made in the form of elaborate essays. They would strongly urge the encouragement of brief communications, in greater number, as at once more calculated to give general interest to the ordinary meetings, and to elicit such results of personal knowledge and observation as are best calculated to add to the true value of the published proceedings.

"Short notices of natural phenomena, features of local geology, objects of natural history, and the like subjects, derived from personal observation, must be readily producible by many members who have hitherto borne no active part in the Society's proceedings, but whose contributions would most effectually promote the objects which it is designed to accomplish."

Extract from the Annual Report of 1855.

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The next Number of this Journal will be issued in March.

THE

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CANADIAN INSTITUTE.

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CANADIAN SALMON LEAPS.

THE CANADIAN JOURNAL.

NEW SERIES.

No. VII.—JANUARY, 1857.

THE DECREASE, RESTORATION, AND PRESERVATION OF SALMON IN CANADA.

BY THE REV. WILLIAM AGAR ADAMSON, D.C.L.

Read before the Canadian Institute, December 6th, 1856.

Brillat Savarin, in his "Physiologie du Gout," asserts that the man who discovers a new dish does more for the happiness of the human race than he who discovered the Georgium Sidus. If this be true, then he who could devise means for the preservation and increase of an old, wholesome and highly coveted article of food would not labor in vain, nor would, I imagine, his endeavors be despised by the members of the Canadian Institute, however humble his abilities, and however unskilled he might be in scientific lore. Actuated by this belief, as well as desirous to respond to the demand for co-operation among the members of the Canadian Institute, I would venture to lay before you some notes upon the decrease, restoration, and preservation of the Salmon (*Salmo Salar*) in Canada.

It is unnecessary to magnify the importance of this fish as an economic production, or as an article of commerce. As food it is beyond comparison the most valuable of fresh water fish, both on account of the delicacy of its flavor, and the numbers in which it can be supplied. By prudence, a little exertion, and a very small expense now, it may not only be rendered cheap and accessible to almost every family in Canada, but also an article of no small commercial importance as an export to the United States, in which country, by

pursuing the course which Canada has hitherto imitated, this noble fish has been almost exterminated. Twenty-five or thirty years ago every stream tributary to the St. Lawrence, from Niagara to Labrador on the north side, and to Gaspé basin on the south, abounded with salmon. At the present moment, with the exception of a few in the Jacques Cartier, there is not one to be found in any river between the Falls of Niagara and the city of Quebec. This deplorable decrease in a natural production of great value has arisen from two causes; 1st.—the natural disposition of uncivilized man to destroy at all times and at all seasons whatever has life and is fit for food; and 2nd.—the neglect of those persons who have constructed mill-dams, to attach to them slides, or chutes, by ascending which the fish could pass onwards to their spawning beds in the interior. It is supposed by many that the dust from the sawmills getting into the gills of the salmon prevents them from respirating freely, and so banishes them from the streams on which such mills are situated, but I am persuaded that this is a mistake, for salmon are found in considerable numbers at the mouths of many such streams, below the dams. In the Marguerite, in the Saguenay, at the Petit Saguenays, the Es-quemain, Port Neuf, Rimouski, Metis, and others that might be named, the real cause of the decrease is the insuperable obstacles presented by mill-dams, which prevent them from ascending to the ærated waters, high up the streams, which are essential for the fecundation of their ova, and so for the propagation of the species. Would you then—it may be asked, pull down our mills in order that we might have salmon in our rivers? most certainly not, I reply, for it is quite possible to maintain all our mills, with all their mill-dams, and yet afford to the fish an easy and inexpensive mode of passing upwards to their breeding places.

Marvellous stories are told of the great heights which salmon will leap in order to surmount the obstacles which nature or art may have erected between the lower parts of a stream and the upper waters which are suited to breeding purposes. Natural historians used gravely to tell us that salmon, in order to jump high, were in the habit of placing their tails in their mouths, and then, bending themselves like a bow, bound out of the water to a considerable distance, from twelve to twenty feet. The late Mr. Scrope, in his beautiful book "Days and Nights of Salmon Fishing," calculates that six feet in height is more than the average spring of salmon, though he conceives that very large fish in deep water, could leap much higher. He says, "Large fish can leap much higher than small ones; but

their powers are limited or augmented according to the depth of water they spring from; in shallow water they have little power of ascension, in deep they have the most considerable. They rise very rapidly from the very bottom to the surface of the water by means of rowing and sculling as it were, with their fins and tail, and this powerful impetus bears them upwards in the air, on the same principle that a few tugs of the oar make a boat shoot onwards after one has ceased to row." However this may be, we know that salmon use almost incredible efforts to ascend their native rivers. Modes have recently been adopted in France, in England, Scotland and Ireland, by which they can do so with ease, and which can be much more cheaply applied to Mill-dams in Canada, than in any of the countries above mentioned. This is simply by constructing below each mill-dam a congeries of wooden boxes proportioned to the height of the dam—which could be done, in any weirs I have seen requiring them, for a sum not exceeding twenty dollars. We will suppose that the mill-dam to be passed over is fifteen feet high from the surface of the water, and that the salmon can surmount the height of five feet at a single bound, then it would be only necessary to erect two boxes, each five feet high, one over the other (as in the illustration) to enable the salmon, in three leaps, to reach the waters which nature prompts him to seek for the propagation of his species. In many Canadian rivers—such as Metis, Matane, Rimouski, Trois Saumons, etc.—this simple apparatus might be put in operation for one half the sum I have mentioned, and I trust it has only to be suggested to the gentlemen residing on their banks to arouse their patriotism and excite them to activity in the matter. There can be no doubt that were the mill-dams removed, or boxes constructed adjacent to them, and protection afforded to the spawning fish, many of the rivers in *Upper Canada* would again abound with Salmon. I have myself, within a few years, taken the true Salmo Salar in Lake Ontario, near Kingston, and many persons in Toronto know that they are taken annually at the mouths of the Credit, the Humber and at Bond Head, in the months of May and June, which is earlier than they are generally killed below Quebec. Whether these fish come up the St. Lawrence in the early spring, under the pavement of ice which then rests upon its surface, or whether they have spent the winter in Lake Ontario, is a question which I must leave to naturalists; merely mentioning that there is some foundation for believing that salmon will not only live, but breed, in fresh water, without visiting the sea. Mr. Lloyd, in his interesting work on the field sports of the North of Europe, says,

"Near Katrineberg, there is a valuable fishery for salmon, ten or twelve thousand of these fish being taken annually. These salmon are bred in a lake, and, in consequence of cataracts, cannot have access to the sea. They are small in size and inferior in flavor," which may also be asserted of salmon taken in the neighborhood of Toronto. Mr. Scrope, in his work previously quoted, states that Mr. George Dormer, of Stone Mills, in the Parish of Bridport, put a female of the salmon tribe, which measured twenty inches in length, and was caught by him at his mill-dam, into a small well, where it remained twelve years, became quite tame and familiar, so as to feed from the hand, and was visited by many persons of respectability from Exeter and its neighborhood.

But the fact that salmon are annually taken near the Credit, the Humber and Bond Head is sufficient ground on which to base my argument for the probability that were the tributary streams of the St. Lawrence accessible to them they would ascend and again stock them with a numerous progeny. Even were this found not to be the case,—then we have the system of artificial propagation to fall back upon—a system which according to the Parliamentary Reports of the Fishery Commissioners has been practised with immense success in different parts of Ireland—according to M. Coste, Member of the Institute, and professor of the college of France, in his reports to the French Academy and the French Government, has answered admirably in France, and according to Mr. W. H. Fry and others, quoted by him in his treatise on artificial fish-breeding, has been generally effective in Scotland. This system, as is well known, consists simply of transporting from one river to another the impregnated eggs of the salmon, and placing them in shallow waters with a gentle current where they are soon hatched, and become salmon fry or par and able to take care of themselves. In consequence of the ova of the salmon, which are deposited in the spawning beds in the months of October, November and December, becoming congealed by frost in the subsequent months, Canada appears to offer greater facilities for their safe transport than those countries in which the system has been so successful, but whose climates are more temperate. Surely, supposing this is a mere untried experiment—which is far from being the case—it would be well worth the while of some of the many wealthy and intelligent dwellers upon the banks of our beautiful rivers to test its value, particularly when they call to mind the well known fact in the natural history of the salmon, that he invariably returns to the stream in which his youth was spent, and that so they may calculate

upon having their present barren rivers stocked with as valuable articles of consumption and of commerce as their fowl-houses or their farm-yards.

I shall, for brevity's sake, abstain from enlarging on this subject, merely observing that ample information can be obtained upon it by consulting the works of M.M. Coste and Fry, which are to be found in the libraries and bookshops in this city ; and that in the streams in which it may be put into operation—if there are mill-dams upon them—the artificial construction to enable the fish to descend and ascend to and from the sea will still be requisite.

Having said so much on the decrease and restoration of salmon in Canada, let us now turn our attention for a few moments to their preservation in the rivers in which they still abound. These rivers I believe to be as valuable and inexhaustible as any others upon the face of the globe, but so circumstanced that their capabilities have not been developed, and that one year of neglect will cause their serious injury, if not their utter destruction, as salmon streams. They extend along the northern shore of the St. Lawrence from Quebec to Labrador, a distance of about 500 miles, and are many in number. They are chiefly held under lease from the Government of Canada, by the Hudson's Bay Company, who fish some of them in an unsystematic manner, with standing nets, because they can be conveniently and cheaply so fished, whilst others are left wholly to the destructive spear of the Indian. In the smaller streams on which the fishermen of the company are employed, a series of standing barrier-nets, (which kill indiscriminately every fish of every size and weight,) is used, a process, which in European rivers, would have long since banished salmon from them. But in Canada the high water in the spring enables some of the largest and strongest of the breeding fish to ascend the streams before those nets can be set, and when they get beyond them, they are comparatively safe in the mountain rivers and lakes which never hear a human footfall till winter—which congeals their surfaces into ice—tempts the poor Indian to tread their banks in pursuit of the bear, the marten, the mink and the otter.

In well regulated salmon fisheries in Europe, the fish—by the construction of proper weirs and reservoirs—are almost as much under the control of the managers as the sheep on their farms or the fowl in their poultry-yards. They can send such of them as they please to market, permit the fittest for the purpose to pass on to propagate their kind, allow the young to enjoy life till they become mature, and suffer the sick and unhealthy to return to their invigorating pastures

in the depths of the ocean. But no portion of this system is practised in our American rivers. There is not a salmon weir in the province; and the consequence is, that young and old, kelt and grilse, worthless and unwholesome, the fish are killed by the undiscriminating net and the cruel spear.

It appears to me that the Hudson's Bay Company set little value on these fisheries, and maintain them merely as an accident appertaining to the fur trade which is far more profitable. The approaching termination of their lease and the consequent uncertainty of their tenure may perhaps appear a sufficient reason for their not incurring the expense of erecting weirs, by which much more profit could be made of their fisheries. Unproductive and wasteful as their mode of fishing is, *the protection the Hudson's Bay Company affords is the only present safeguard for the existence of Salmon in Canada.* I am persuaded that *were that protection withdrawn for* ONE SUMMER, *without the substitution of some other as effective, this noble fish would be utterly exterminated from our country.* Fishermen from Gaspé, Rimouski, New Brunswick, Labrador, Newfoundland, the Magdalene Islands and the United States—whose numbers and skill would enable them to do thoroughly what the servants of the H. B. C. from their paucity and inexperience do ineffectually—would swarm up our rivers, and with nets, spears, torches, and every other engine of piscine destruction, would kill, burn and mutilate every fish that ventured into the rivers. Already has this been attempted. For the last two or three years schooners from the United States, have regularly arrived, in the salmon season, at the Bay of Seven Islands, their crews well armed, and have set their nets in the river Moisie, in despite of the officers of the H. B. C. Similar circumstances have occurred at other fishing stations in the tributaries of the St. Lawrence; no means, that I am aware of, having been resorted to for punishing the aggressors or preventing a repetition of their outrages. The river Bersinies has this year (1856) been altogether in the hands of a speculating and rapacious American, who employed the spear of the Indian to furnish him with mutilated salmon, several boxes of which he brought to this city, in the month of September, when they were out of season, unfit for food and flavorless, having previously glutted the markets of Portland, Boston and New York with more palatable fish.

There can be but little doubt that many of the salmon streams in Lower Canada would be as productive, under proper management, as rivers in Europe for which large annual rents are paid; but it must

be admitted that the great distance at which they are situated from Civilization, the want of the means of intercourse between them and the inhabited parts of the country, the liability to trespass by armed ruffians, and the dreadful rigor of the climate in winter, present very serious obstacles to those who might wish to undertake such management: for obviating some of which I see no better method than the employment, during the summer months, of one or two armed steamers of light draught of water, such as are used for a similar purpose on the east coast of Denmark. These steamers should each have a commander on board, who should be a magistrate and empowered by parliament to act summarily in cases of infraction of the Fishery Laws, and beside supplying the lighthouses and other public works with stores, oil, building materials, etc., conveying the workmen managers and fishermen to their several stations, and protecting the lessees of the Province, might also be profitably employed as the means of transporting the fresh caught salmon from the several rivers, packed in ice, to the Rail-road Stations at St. Thomas and Quebec; from whence they could be distributed to the markets of Canada and the United States. Two Bills for the protection of salmon and trout in Lower Canada have recently become Acts of Parliament. These may possibly be productive of some good in civilized and inhabited districts, but must be utterly ineffective in those parts of the Province where there are no settled inhabitants, no magistrates, and no tribunals before which those who infringe the Law can be cited; and this is the case of all the best rivers in Lower Canada.

I cannot close these observations without endeavoring to impress on all who hear me, the necessity for prompt action in this matter; for there can be no doubt upon the mind of any man who is acquainted with the localities, that if the King's Posts should be abandoned by the Hudson's Bay Company, before some well devised system be adopted for carrying on the work which they have hitherto effected, two melancholy results will be the inevitable consequences, viz.—the salmon rivers will be taken possession of by hordes of lawless men, who will in no way contribute to the revenue of the country, but will quickly and recklessly exterminate the fish, and then desert our shores, leaving behind them no trace of their temporary occupation except the destruction they have wrought—and more terrible still—a whole tribe of Indians (the Montagnards) will be reduced to a state of positive starvation, for upon the Hudson's Bay Company they have hitherto been, and are now dependent for their ammunition, guns, and other means by which they obtain their food and clothing.

ON PRESERVING TIMBER FROM DECAY.

BY JOSEPH ROBINSON, TORONTO.

Read before the Canadian Institute, December 20th, 1856.

The economic value of timber, and the immense outlay required for the constant restoration of works executed in the cheaper but least durable varieties of woods, have long directed the attention of practical men to the desirableness of discovering some process by which greater durability could be given to a material, in all other respects so admirably adapted to the objects in view, without affecting its original cost to such an extent as to render it no longer available for the numerous ordinary purposes to which it is now applied. To this subject, attention was anew directed in the last number of the *Canadian Journal*, in an article on the "Preservation of Timber;"* and it may not be out of place, by way of adding to the existing fund of information upon a subject of such general interest, to bring before the Institute, a well attested and valuable process invented and used by the eminent French chemist, Dr. Boucherie.

This process is the result of twenty years experimental labor and study, and is regarded in France and England as of the highest importance; being the only mode yet brought into practical and extensive application, by which the durability of woods, liable to decay, can be economically and effectually secured.

It accomplishes two objects: first, that of expelling the sap; and, secondly, filling the pores of the timber with a preservative solution.

The mode of impregnating trees hitherto adopted, has been by saturation only, assisted sometimes by great pressure, and by previously subjecting the timber in cylinders to a vacuum or to heat.

Dr. Boucherie's process differs entirely: inasmuch as he applies a moderate pressure, and to one end only of the sap tubes of the tree, the effect of which is to expel the sap by the preserving liquor which takes its place. By some of the processes hitherto used, the sap (the fermentation of which is admitted to be the cause of decay) is allowed to remain in the tree; in the process now under review, the sap is expelled, and the tubes are thoroughly cleansed from the fermenting matter, which is displaced by an injected solution of a preservative nature.

The tubular structure of trees has been long known, but it has not

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* *Vide* Vol. I., p. 559. New Series.

been known that no connexion exists between the tubes laterally; and this is shewn by the interesting experiment of stopping up or shutting off certain of the sap-tubes at the end of the tree, leaving exposed such as form a word: which word, or name, by the injection of a coloring liquor, can be driven from one end of the tree to the other; so that wherever the tree is cut through, the name appears distinctly in colored letters on the exposed sections.

This experiment is interesting, not only in a scientific point of view; but it shews that none of the processes hitherto used, wherein lateral pressure is involved, can force any preserving liquor into a tree without a degree of violence, which must injure the fibre of the wood, and destroy its strength and use for many purposes.

The advantages which would result from expelling the sap and replacing it by an antisceptic fluid, have been long known; and the idea of effecting this by applying the fluid under pressure at the end of a piece of timber is not new, having been suggested and patented many years ago by Mr. Bethel. But the means then used did not accomplish the object in such a manner as to admit of its commercial application. Hence the more expensive process of creosoting has been adopted; where the timber is totally immersed in the oil, under pressure, a method which does not permit the sap to escape.

By the old process of violent pressure, the preserving liquor is forced at right angles to the tubes through the woody fibre of the tree, injuring its strength as well as its capability, in railway sleepers, for example, to resist the wear of the chairs; consuming at the same time an unnecessary amount of the preserving liquor, without (whatever pressure may be applied) thoroughly impregnating the timber, while one-sixth or one-eighth of the force only is necessary by the new process, and the portion alone requiring the preservative infusion, viz. the soft matter between the rings, is impregnated, the woody fibre remaining unbroken and undisturbed.

Another important advantage in Dr. Boucherie's process, is derived from the simplicity and moderate cost of the apparatus, which, for operations on a small scale, will not exceed £10 or £15, and for a railway of two hundred miles, under £50.

The practical application and entire success of this invention in Europe will be seen by the printed official reports. The first of these was made, by order of the French Government, in the year 1850, the second in 1852, and the third in 1856: being an abstract from the official jury report of the Exposition Universelle of 1855, whereby it will be seen that the distinguished honor of one of the large gold

medals was awarded to Dr. Boucherie, of which only four were conferred in all.

The mode of application is as follows :—Soon after the tree is felled, a saw-cut is made in the centre, through about nine-tenths of its section. The tree is slightly raised by a lever or wedge at its centre, and the saw-cut thereby partially opened ; a piece of string is then placed round the cut, close to the outer circumference of the tree, the support is withdrawn, and the saw-cut closes on the string, thereby making a water-tight joint. An auger-hole is then bored obliquely into the saw-cut ; a wooden tube is driven into the hole, the conical end of which is attached to a flexible pipe, which is in connexion with a cistern or reservoir, at an elevation of from 30 to 40 feet above the tree intended to be preserved.

When it is necessary to prepare timber in long lengths, a cap is placed at the end of the tree by screws or dogs. The most efficacious solution is composed of sulphate of copper and water, mixed in the proportion of 1 to 100. The strength is easily ascertained, by any intelligent workman, by an hydrometer ;—and the cost of such a solution is so trifling, as to offer no impediment to its universal application for the purpose in view.*

It would be difficult to enumerate all the classes to be benefitted by this invention, and the uses to which it may be applied. Railway companies, ship-builders, telegraph companies, and land owners, would alike benefit by it. Post and rail fencing, field gates, wood farm buildings, frame buildings, and dwellings in general, would last many additional years. Mr. R. Stephenson, the President of the Institute of Civil Engineers, in his inaugural address, adverts to the great consumption of railway sleepers by decay, and estimates it at 2,600,000 per annum, costing upwards of £500,000. Taking the resistance

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* On comparing the above account of Boucherie's process with that described in the *Canadian Journal* (No. 6, pp. 559–561) and for which a patent was taken out in May, 1856, the two processes appear to be identical so far as the employment of hydraulic pressure is concerned, and if such is the case, this part of the patent is void.

The following is the text of the Patent Law bearing upon this point. " If at " the trial in any such action [*for infringement of Patent,*] it shall be made appa- " rent to the satisfaction of the Court....that the thing thus secured by Patent " was not originally discovered by the Patentee, or party claiming to be the " Inventor or Discoverer in the specification referred to in the Patent, but had " been in use, or had been described in some public work, anterior to the supposed " discovery of the Patentee......the Patent shall be declared void." 13 and 14 Vict, " 79, c. 8.—(*Ed. Can. Jour.*)

of the proposed sleepers to decay as the only basis of the calculation, a large proportion of this sum would be saved. Assuming the duration of the sleeper to be doubled, and taking into account the mechanical causes of destruction, a saving of £300,000 per annum, would be effected to the railway interest in England alone.

From these data, the value of the invention in Europe will readily be seen, and although it has been patented in France and England, and, as it would seem, to some extent, in Canada, it is believed that the use in this Province is unfettered; 1st, because by the Statutes of Canada, no foreigner can obtain a patent monopoly in this country; and, 2nd, because, being already known and used in other countries, it cannot be patented here.

THE CHINOOK INDIANS.

BY PAUL KANE, TORONTO.

In accordance with an invitation of the Council of the Canadian Institute to communicate notices of some of the tribes of Indians amongst whom I have travelled, I selected the Chinooks, one of the tribes most remote from this part of the continent, and whose manners and customs are so much at variance with our own, as to render some notice of them, from personal observation, probably both novel and interesting. Other communications of the incidents and results of my travels among the Indians of the North West, having since appeared in the Journal, I have revised my account of the Chinooks, with a view to its appearance, along with the notices of the Walla Wallas, and others of the Aborigines of this continent in the New Series.

The Flat-Head Indians are met with along the banks of the Columbia river from its mouth eastward to the Cascades, a distance of about 130 miles; they extend up the Walamett river south about 30 or 40 miles, and through the district lying between the Walamett and Fort Astoria, now called Fort George. To the north they extend along the Cowlitz river and the tract of land lying between that and Puget's Sound. About two-thirds of Vancouver's Island is also occupied by them, and they are found along the coasts of Puget's Sound and the Straits of Juan de Fuca. The Flat-Heads are divided into numerous tribes, each having its own peculiar locality, and differing more or less from the others in language, customs, and manners.

Of these I have selected, as the subject of the present paper, the Chinooks, a tribe inhabiting the tract of country at the mouth of the Columbia river. Residing among the Flat-Heads, I remained from the fall of 1846 to the following autumn of 1847, and had consequently ample opportunity of becoming acquainted with the peculiar habits and customs of the tribe. They are governed by a Chief called Casenov. This name has no translation: the Indians on the west side of the Rocky Mountains differing from those on the east, in having hereditary names, to which no particular meaning appears to be attached, and the derivation of which is in many instances forgotten. Casenov is a man of advanced age, and resides principally at Fort Vancouver, about 90 miles from the mouth of the Columbia. I made a sketch of him while staying there, and obtained the following information as to his history :—Previous to 1829 Casenov was considered a great warrior, and could lead into the field 1,000 men, but in that year the Hudson's Bay Company and emigrants from the United States introduced the plough for the first time into Oregon, and the locality, hitherto considered one of the most healthy, was almost depopulated by the fever and ague.

Chinook Point, the principal settlement of the tribe, at the mouth of the river, where King Cumcomley ruled in 1811, was nearly reduced to one-half its numbers. The Klatsup village now contains but a small remnant of its former inhabitants. Wasiackum, Catlamet, Kullowith, the settlements at the mouth of the Cowlitz, Kallemo, Kattlepootle and Walkumup are entirely extinct as villages. On Sovey's Island there were formerly four villages but now there scarcely remains a lodge. They died of this disease in such numbers that their bodies lay unburied on the river's banks, and many were to be met with floating down the stream. The Hudson's Bay Company supplied them liberally with Quinine and other medicines, but the good effects of these were almost entirely counteracted by their mode of living and obstinacy in persisting in their own peculiar mode of treatment, which consisted principally in plunging into the river without reference to the particular crisis of the disease.

From these causes the numbers of the Indians have been very much reduced, and the effective power of the tribes so greatly diminished that the influence which Casenov owed to the number of his followers has correspondingly declined; his own immediate family consisting of ten wives, four children, and eighteen slaves, being reduced in one year to one wife, one child, and two slaves. Their decrease since that time has also been fearfully accelerated by the introduction of

ardent spirits, which, in spite of prohibition and fines against selling it to Indians, they manage to obtain from their vicinity to Oregon city, where whiskey, or a poisonous compound called there *blue ruin*, is illicitly distilled. I have scarcely ever met with an Indian in that vicinity who would not get drunk if he could procure the means, and it is a matter of astonishment how very small a quantity suffices to intoxicate these unfortunate beings, although they always dilute it largely in order to prolong the pleasure they derive from drinking.

Casenov is a man of more than ordinary talent for an Indian, and he has maintained his great influence over his tribe chiefly by means of the superstitious dread in which they hold him. This influence was wielded with unflinching severity towards them, although he has ever proved himself the firm friend of the white man. For many years, in the early period of his life, he kept a hired assassin to remove any obnoxious individual against whom he entertained personal enmity. This bravo, whose occupation was no secret, went by the name of Casenov's *Skōcoom* or evil genius. He finally fell in love with one of Casenov's wives who eloped with him. Casenov vowed vengeance, but the pair for a long time eluded his search, until one day he met her in a canoe near the mouth of the Cowlitz river and shot her on the spot. After this he lived in such continual dread of the lover's vengeance that for nearly a year he never ventured to sleep, but in the midst of a body guard of forty armed warriors, until at last he succeeded in tracing his foe out, and had him assassinated by the man who had succeeded him in his old office.

The Chinooks over whom Casenov presides carry the process of flattening the head to a greater extent than any other of the Flat-Head tribes. The process is as follows:—The Indian mothers all carry their infants strapped to a piece of board covered with moss or loose fibres of cedar bark, and in order to flatten the head they place a pad on the forehead of the child, on the top of which is laid a piece of smooth bark bound on by a leathern band passing through holes in the board on either side and kept tightly pressed across the front of the head. A sort of pillow of grass or cedar fibres is placed under the back of the neck to support it.

This process commences with the birth of the infant, and is continued for a period of from eight to twelve months, by which time the head has lost its natural shape and acquired that of a wedge, the front of the skull becoming flat, broad, and higher at the crown, giving it a most unnatural appearance.

It might be presumed that from the extent to which this is

carried the operation must be attended with great suffering to the infant, but I never heard the infants crying or moaning, although I have seen their eyes seemingly starting out of the sockets from the great pressure. But on the contrary, when the bandages were removed I have noticed them cry until they were replaced.

From the apparent dullness of the children whilst under the pressure I should imagine that a state of torpor or insensibility is induced, and that a return to consciousness occasioned by its removal must be naturally followed by the sense of pain.

This unnatural operation does not however seem to injure the health, the mortality amongst the Flat-Head children not being perceptibly greater than amongst other Indian tribes. Nor does it seem to injure their intellect; on the contrary, the Flat-Heads are generally considered fully as intelligent as the surrounding tribes who allow their heads to preserve their natural shape; and it is from amongst the round-heads that the Flat-Heads take their slaves. They look with contempt even upon the whites for having round-heads, the *flat-head* being considered as the distinguishing mark of freedom. I may here remark, that, amongst the tribes who have slaves there is always something which conspicuously marks the difference between the slave and the free, such as the Chimseyan, who wear a ring in the nose, and the Babbenes who have a large piece of wood inserted through the under lip. The Chinooks, like all other Indian tribes, pluck out the beard on its first appearance.

I would give a specimen of the barbarous language of these people, were it not impossible to represent by any combination of the letters of our alphabet the horribly harsh, gasping, spluttering sounds which proceed from their throats, apparently unguided either by the tongue or lips. It is so difficult to acquire a mastery of their language that none have been able to attain it unless those who have been born amongst them. They have, however, by their intercourse with the English and French traders succeeded in amalgamating, after a fashion, some words of each of these tongues with their own, and have formed a sort of Patois, barbarous enough certainly, but still sufficient to enable them to communicate with the traders.

This Patois I succeeded, after some short time, in acquiring, and could converse with most of the chiefs with tolerable ease. Their common salutation is *Clah hoh ah yah*, originating, as I believe in their having heard in the early days of the fur trade a gentleman named Clark frequently addressed by his friends, "Clark, how are you?" This salutation is now applied to every white man, their own

language affording no appropriate expression. Their language is also peculiar in containing no oaths, or any words expressive of gratitude or thanks.

Their habits are extremely filthy, their persons abounding with vermin, and one of their chief amusements consists in picking these disgusting insects from each others' heads and eating them. On my asking an Indian one day why he ate them, he replied that they bit him and he gratified his revenge by biting them in return. It may naturally be supposed that they are thus beset from want of combs or other means of displacing the intruders; but this is not the case, they pride themselves on carrying such companions about them, and giving their friends the opportunity of amusing themselves in hunting and eating them.

The costume of the men consists of a musk-rat skin robe, the size of one of our ordinary blankets, thrown over the shoulders, without any breech-cloth, moccassins or leggings. Painting the face is not much practised amongst them except on extraordinary occasions, such as the death of a relative, some solemn feast, or going on a war party. The female dress consists of a girdle of cedar bark round the waist, with a dense mass of strings of the same material hanging from it all around and reaching almost to the knees. This is their sole summer habiliment. They, however, in very severe weather add the musk-rat blanket. They also make another description of blanket from the skin of the wild goose, which is here taken in great abundance. The skin is stripped from the bird with the feathers on, and cut into strips, which they twist so as to have the feathers outwards. This makes a feathered cord, and is then netted together so as to form a blanket, the feathers filling up the meshes, and rendering it a light and very warm covering. In the summer these are entirely thrown aside, not being in any case worn from feelings of delicacy, and the men go quite naked, though the women always wear the cedar petticoat.

The country which the Chinooks inhabit being almost destitute of furs they have little to trade in with the whites. This, coupled with their laziness—probably induced by the ease with which they procure fish, which is their chief subsistence—prevents their obtaining ornaments of European manufacture, consequently anything of the kind is seldom seen amongst them. They, however, wear long strings of small shells found on the coast called Ioquas, and used by them also as money.

A great traffic is carried on amongst all the tribes through the medium of these shells, which are found only at Cape Flattery, at the

entrance to the Straits of De Fuca. They are fished up from the bottom of the sea, and are found an inch and a-half to two inches in length; they are white, slender, hollow, and tapering to a point, slightly curved, and about the size of the stem of an ordinary clay tobacco pipe. They are valuable in proportion to their length, and their value increases according to a fixed ratio, forty shells being the standard number required to extend a fathoms' length, which number is in that case equal in value to a beaver's skin, but if thirty-nine be found long enough to make the fathom it would be worth two beaver skins, if thirty-eight three skins, and so on, increasing one beaver skin for every shell less than the standard number.

The Chinooks evince very little taste in comparison with some of the tribes on the eastern side of the Rocky Mountains, in ornamenting either their persons or their warlike or domestic implements. The only utensils I saw at all creditable to their decorative skill were carved bowls and spoons of horn, and baskets made of roots and grass woven so closely as to serve all purposes of a pail in holding and carrying water. In these they even boil the salmon which constitute their principal food. This is done by immersing the fish in one of the baskets filled with water, into which they throw red hot stones until the fish is cooked, and I have seen fish dressed as expeditiously by them in this way as if done in a kettle over a fire by our own people.

The salmon is taken during the months of June and July in immense numbers in the Columbia river and its tributaries by spearing and with gill nets. They have also a small hand net something like our common landing net, which is used in rapids where the salmon are crowded together and near the surface. These nets are ingeniously contrived, so that when a fish is in them his own struggles loosen a little stick which keeps the mouth of the net open while empty, but which, when the net is full, immediately draws it together like a purse with the weight of the salmon and effectually secures the prey.

The salmon taken during this period of the year are split open and dried in the sun for their winter's supply. I have never seen salt made use of by any tribe of Indians for the purpose of preserving food, and they all evince the greatest dislike to salt meat.

I may here mention a curious fact respecting the salmon of the Columbia river; they have never been known to rise to a fly, although it has been frequently tried by gentlemen of the Hudson's Bay Company, with the very best tackle. The salmon go up the river as far as they possibly can and into all its tributary streams in myriads; it is, however, a well known fact that after spawning they never

return to the sea, but all die in the river; the Columbia is hardly ever free from gill nets, and no salmon has ever been taken returning; and in the fall, wherever still water occurs, the whole place is tainted by their putrid bodies floating in immense masses. I have been obliged to travel through a whole night trying to find an encampment free from their disgusting effluvia.

The Chinooks also catch a considerable number of sturgeon, which here attain to an enormous size, weighing from four to six cwt.; this is done by means of a long-jointed spear handle seventy or eighty feet in length, fitted into, but not actually fastened to a barbed spear-head, to which is attached a line, with this they feel along the bottom of the river, where the sturgeon are found lying at the spawning season. Upon feeling the fish the barbed spear is driven in and the handle withdrawn. The fish is then gradually drawn in by the line, which being very long allows the sturgeon room to waste his great strength, so that he can with safety be taken into the canoe or towed ashore.

At the mouth of the river a very small fish, about the size of our Sardine, is caught in immense numbers. It is called there Uhlékun, and is much prized on account of its delicacy and extraordinary fatness. When dried this fish will burn from one end to the other with a clear steady light like a candle. The Uhlékuns are caught with astonishing rapidity by means of an instrument about seven feet long; the handle is about three feet, into which is fixed a curved wooden blade about four feet, somewhat the shape of a sabre, with the edge at the back. In this edge, at the distance of an inch and a-half, are inserted sharp bone teeth about an inch long. The Indian standing in the canoe draws this edgeways with both hands, holding it like a paddle, rapidly through the dense shoals of fish which are so thick that almost every tooth will strike a fish. One knock across the thwarts safely deposits them in the bottom of the canoe. This is done with such rapidity that the Indians will not use nets for this description of fishing.

There are few whales now caught on the coast, but the Indians are most enthusiastic in the chase. Upon a whale being seen blowing in the offing they rush down to their large canoes and push off, with ten or twelve men in each. The canoes are furnished with a number of strong seal skin bags filled with air, and made with great care and skill, capable of containing about ten gallons. To each bag is attached a barbed spear-head by a strong string about eight or nine feet long, and in the socket of the spear-head is fitted a handle five or

six feet in length. Upon coming up with the whale, the barbed heads, with the bags attached, are driven into it and the handles withdrawn. The attack is continually renewed until the whale is no longer able to sink from the buoyancy of the bags, when he is despatched and towed ashore. The blubber of the whale is much prized amongst them, and is cut into strips about two feet long and four inches wide, and eaten generally with their dried fish.

Clams and oysters are very abundant, and seals, wild ducks and geese, are taken in great plenty, but their fishing is so productive that the Indians subsist with little labour. They are also very fond of herrings' roe, which they collect in the following manner :—They sink cedar branches to the bottom of the river, in shallow places, by placing upon them a few heavy stones, taking care not to cover the green foliage, as the fish prefer spawning on anything green, and they literally cover all the branches by next morning with spawn. The Indians wash this off in their water-proof baskets, to the bottom of which the roe sinks ; this is squeezed by the hands into little balls and then dried, and is very palatable.

The only vegetables in use amongst the Chinooks are the Camas and Wappattoo. The Camas is a bulbous root much resembling the onion in outward appearance but is more like the potato when cooked and is very good eating. The Wappattoo is somewhat similar but larger and not so dry or delicate in its flavour. They are found in immense quantities in the plains in the vicinity of Fort Vancouver, and in the spring of the year present a most curious and beautiful appearance, the whole surface presenting an uninterrupted sheet of bright ultramarine blue from the innumerable blossoms of these plants. They are cooked by digging a hole in the ground, then putting down a layer of hot stones, covering them with dry grass, on which the roots are placed ; they are then covered with a layer of grass, and on the top of this they place earth, with a small hole perforated through the earth and grass down to the vegetables. Into this they pour water, which, reaching the hot stones, forms sufficient steam to completely cook the roots in a short time, the hole being immediately stopped up after the introduction of the water. They often adopt the same ingenious process for cooking fish, meat, and game.

There is another article of food made use of amongst them, which from its disgusting nature I should have been tempted to omit, were it not a peculiarily characteristic trait of the Chinook Indian, both from its extraordinary character, and its use being confined solely to this tribe ; it is, however, regarded only as a luxury and not as a general

article of food. The whites have given it the name of Chinook Olives, and it is prepared as follows :—About a bushel of acorns are placed in a hole dug for the purpose close to the entrance of the lodge or hut, and covered over with a thin layer of grass, on top of which is laid about half a foot of earth; every member of the family for the next five or six months regards this hole as the special place of deposit for urine, which is on no occasion to be diverted from its legitimate receptacle. Even should a member of the family be sick and unable to reach it for this purpose, the fluid is carefully collected and carried thither. However disgusting such an cdoriferous preparation would be to people in civilized life the product is regarded by them as the greatest of all delicacies; so great indeed is the fondness they evince for this horrid preparation that even when brought amongst civilized society they still yearn after it and will go any distance to obtain it. A gentleman in charge of Fort George had taken to himself a wife, a woman of this tribe, who of course partook with himself of the best food the Fort could furnish; notwithstanding which, when he returned home one day his nostrils where regaled with a stench so nauseating that he at once enquired where she had deposited the Chinook olives, as he knew that nothing else could poison the atmosphere in such a manner. Fearful of losing her dearly-prized luxury she strenuously denied their possession: his nose however, led him to the place of deposit, and they were speedily consigned to the river. His mortification was afterwards not a little increased by learning that she had purchased the delicacy with one of his best blankets.

During the season the Chinooks are gathering Camas and fishing, they live in lodges constructed by means of a few poles covered with mats made of rushes, which can be easily moved from place to place; but in the villages they build permanent huts of split cedar boards. Having selected a dry place for the village, a hole is dug about three feet deep and about twenty feet square: round the sides of this, square cedar boards are sunk and fastened together with cords and twisted roots, rising about four feet above the outer level; two posts are sunk at the middle of each end with a crutch at top, on which the ridge pole rests, and boards are laid from thence to the top of the upright boards. Fastened in the same manner round the interior are erected sleeping places, one above another, something like the berths in a vessel, but larger. In the centre the fire is made, the smoke of which escapes by means of a hole left in the roof for that purpose. These lodges are filthy beyond description and swarm with vermin. The fire is procured by means of a flat piece of dry cedar, in which a small hol-

low is cut, with a channel for the ignited charcoal to run over; this piece the Indian sits on, to hold it steady, while he rapidly twirls a round stick of the same wood between the palms of his hands with the point pressed into the hollow of the flat piece. In a very short time sparks begin to fall through the channel upon finely frayed cedar bark placed underneath, which they soon ignite. There is a great deal of knack in doing this, but those who are used to it will light a fire in a very short time. The men usually carry these sticks about with them, as after they have been once used they produce the fire quicker.

The only warlike implements I have seen amongst the Chinooks were bows and arrows. The bows are made from the Yew tree, and the arrows are feathered and pointed with sharp bone. These they use with great precision.

Their canoes are hollowed out of the cedar, and some of them are very large, as this tree grows to an immense size in the neighbourhood. They make them exceedingly light, and from their formation they are capable of withstanding very heavy seas.

Slavery is carried on to a great extent along the North-West coast and in Vancouver's Island; and the Chinooks, considering how much they themselves have been reduced in numbers, still retain a large number of slaves. These are usually procured from the Chastay tribe who live near the Umqua, a river south of the Columbia emptying into the Pacific. They are sometimes seized by war parties, but are often bought from their own people. They do not flatten the head, nor is the child of one of them (although by a Chinook father,) allowed this distinguishing mark of freedom. Their slavery is of the most abject description: the Chinook men and women treat them with great severity, and exercise the power of life and death at pleasure. An instance of the manner in which the Chastay slaves are treated presented itself to my own observation one morning while I was out sketching on Vancouver's Island. I saw upon the rocks the dead body of a young woman whom I had seen a few days previously walking about in perfect health, thrown out to the vultures and crows. I mentioned it to a gentleman of the Hudson's Bay Company, who accompanied me to the lodge she belonged to, where we found an Indian woman, her mistress, who made light of her death, and who was no doubt the cause of it. She said a slave had no right to burial. She was furious on being told that the slave was as good as herself. "She, the daughter of a chief, no better than a slave!" She then stalked out of the lodge with great dignity; the next morning she had taken

down the lodge and was gone. I was also told by an eye witness, of a chief who, having erected a colossal idol of wood, sacrificed five slaves to it, barbarously murdering them at its base, and asking in a boasting tone who among them could afford to kill so many slaves. One of these slaves was a handsome girl who had lived from her infancy in his family, and begging most piteously for life, reminded him of the care she had taken of his children and all the services she had rendered; but her pleadings were of no avail, and the brutal wretch with his own hand plunged a knife four times into her body before she ceased her appeals for mercy. The only distinction made in her favour was that she was buried, instead of being, like her miserable companions, thrown out on the beach.

The principal amusement of the Chinooks is gambling, which is carried to great excess amongst them. You never visit the camp but you hear the monotonous gambling song of "he ha, ha," accompanied by the beating of small sticks on some hollow substance. Their games do not exceed two or three, and are of a simple nature. The one most generally played consists in holding in each hand a small piece of stick the thickness of a goose quill and about an inch and a-half in length, one plain and the other distinguished by a little thread wound round it, the opposite party being required to guess in which hand the marked stick is to be found. A Chinook will play at this simple game for days and nights together, until he has gambled away everything he possesses, even his wife. They play, however, with much equanimity, and I never saw any ill-feeling evinced by the loser against his successful opponent. They will cheat if they can, and pride themselves on its success; if detected no unpleasant consequence follows, the offending party being merely laughed at and allowed to amend his play.

Another game to which the Chinooks are very partial is played by two or three on each side. The rivals sit on the ground opposite each other with the stakes lying in the centre, one begins with his hands on the ground in which he holds four small sticks covered from sight by a mat, these he arranges in any one of a certain number of forms prescribed by the rules of the game, and his opponent on the opposite side endeavours to guess which form he has chosen; if successful a mark is stuck up in his favour, and the sticks are handed to the next, if not the player counts and still goes on till discovered. When those on one side have gone through, the others commence. At the conclusion the marks are counted and the holder of the greater number wins. This game is also accompanied by singing, in which all the bystanders join.

Another game which I have seen amongst them is called Al-kol-loch, and is one that is universal along the Columbia river. It is considered the most interesting and important as it requires great skill. A smooth level piece of ground is chosen, and a slight barrier of a couple of sticks laid lengthways is made at each end. These are forty or fifty feet apart and a few inches high. The two opponents, stripped naked, are armed each with a very slight spear about three feet long and finely pointed with bone. One of them takes a ring made of bone or some heavy wood, about three inches in diameter, and wound round with cord, on the inner circumference of which are fastened six beads of different colours at equal distances, to each of which a separate numerical value is attached; the ring is then rolled along the ground to one of the barriers and is followed at the distance of two or three yards by the players, and as the ring strikes the barrier and is falling on its side the spears are thrown so that the ring may fall on them; if only one of the spears should be covered by the ring the owner of it counts according to the coloured bead over it. But it generally happens, from the dexterity of the players, that the ring covers both spears, and each count according to the colours of the beads above his weapon. They then play towards the other barrier, and so on until one party has attained the number agreed upon for game.

The Chinooks have tolerably good horses, and are fond of racing, at which they bet considerably; they are expert jockeys and ride fearlessly. They also take great delight in a game with a ball, which is played by them in the same manner as by the Cree, Chippewa, and Sioux Indians. Two poles are erected about a mile apart, and the company is divided into two bands armed with sticks, having a small ring or hoop at the end, with which the ball is picked up and thrown to a great distance, each party then strives to get the ball past their own goal. There are sometimes hundreds on a side, and the play is kept up with great noise and excitement. At this game they also bet heavily, as it is generally played between tribes or villages.

The sepulchral rites of this singular tribe of Indians are too curious to be entirely omitted. Upon the death of a Chinook the body is securely tied up in rush matting and placed in the best canoe they can procure, without any peculiar ceremonies. This canoe is as highly decorated as the family of the deceased can afford. Tin cups, kettles, plates, pieces of cotton, red cloth, and furs, and in fact everything which they themselves most value, and which are most difficult for them to obtain, are hung round the canoe; inside, beside the body

they place paddles, spears, bows and arrows, and food, with everything else which they consider necessary for a very long journey. I have even found beads, Ioquas shells, brass buttons, and small coins in the mouths of the skeletons. The canoe is then taken to the bur ial place of the tribe, generally selected for its isolated situation. The two principal places are rocky islands in the lower part of the Columbia River. One is called Coffin Rock from the appearance it presents, covered with the raised biers of the deceased members of the tribe. To these they tow the canoe, which is then either fastened up in a tree or supported on a sort of frame four or five feet from the ground made of strong cedar boards, and holes bored in the bottom of the canoe to let the water run out; it is then covered with a large piece of bark to protect it from the rain. Before leaving, the usefulness of every article left with the corpse is destroyed, by making holes in the kettles, cans, and baskets, cracking the bows, arrows, and spears, and if there is a gun they take the lock off, believing that the Great Spirit will mend them upon the deceased arriving at the hunting grounds of their Elysium. The greatest crime which an Indian can commit in the eyes of his people is that of desecrating one of these canoes, and it very seldom happens that the slightest thing is removed.

In obtaining a specimen of one of the peculiarly formed skulls of the tribe I had to use the greatest precaution, and ran no small risk not only in getting it, but in having it in my possession afterwards. Even the voyageurs would have refused to travel with me had they known that I had it among my collections, not only on account of the superstitous dread in which they hold these burial places, but also on account of the danger arising from a discovery, which might have cost the lives of the whole party.

A few years before my arrival at Fort Vancouver, Mr. Douglass, who was then in charge, heard from his office in the Fort the report of a gun inside the gates; this being a breach of discipline he hurried out to enquire the cause of so unusual a circumstance, and found one of Casenov's slaves standing over the body of an Indian whom he had just killed, and in the act of reloading his gun with apparent indifference, Casenov himself standing by. On Mr. Douglass arriving at the spot, he was told by Casenov, with an apology, that the man deserved death according to the laws of the tribe, who, as well as the white man inflicted punishment proportionate to the nature of the offence. In this case the crime was one of the greatest an Indian could be guilty of, namely, the robbing the sepulchre canoes. Mr.

Douglass after severely reprimanding him allowed him to depart with the dead body.

Sacred as the Indians hold their burial places, Casenov himself, a short time after the latter occurrence, had his only son buried in the cemetery of the fort. He died of consumption—a disease very frequent amongst all Indians—proceeding no doubt from their constant exposure to the sudden vicissitudes of the climate. The coffin was made sufficiently large to contain all the necessaries supposed to be required for his comfort and convenience in the world of spirits. The chaplain of the fort read the usual service at the grave, and after the conclusion of the ceremony, Casenov returned to his lodge, and the same evening attempted, as narrated below, the life of the bereaved mother, who was the daughter of the great chief generally known as King Comcomly, so beautifully alluded to in Washington Irving's "Astoria." She was formerly the wife of a Mr. McDougall, who bought her from her father for, as it was supposed, the enormous price of ten articles of each description, guns, blankets, knives, hatchets, &c., then in Fort Astoria. Comcomly, however, acted with unexpected liberality on the occasion by carpeting her path from the canoe to the Fort with sea otter skins, at that time numerous and valuable, but now scarce, and presenting them as a dowry, in reality far exceeding in value the articles at which she had been estimated. On Mr. McDougall's leaving the Indian country she became the wife of Casenov.

It is the prevailing opinion of the chiefs that they and their sons are too important to die in a natural way, and whenever the event takes place they attribute it to the malevolent influence of some other person, whom they fix upon, often in the most unaccountable manner, frequently selecting those the most dear to themselves and the deceased. The person so selected is sacrificed without hesitation. On this occasion Casenov selected the afflicted mother, notwithstanding she had during the sickness of her son been most assiduous and devoted in her attentions to him, and of Casenov's several wives she was the one he most loved; but it is the general belief of the Indians on the west side of the mountains, that the severer the privation they inflict upon themselves the greater is therefore the manifestation of their grief, and the more pleasing to the departed spirit. Casenov assigned to me, as an additional motive for his wish to kill his wife, that as he knew she had been so useful to her son and so necessary to his happiness and comfort in this world, he wished to send her with him as his companion on his long journey. She, how-

ever, escaped into the woods, and next morning reached the Fort, imploring protection; she was accordingly secreted for several days until her own relations took her home to Chinook Point. In the meantime a woman was found murdered in the woods and the act was universally attributed to Casenov or one of his emissaries.

I may here mention a painful occurence which took place on Thompson's River, in New Caledonia, in further illustration of this peculiar superstition. A Chief dying, his widow considered a sacrifice as indispensable, but having selected a victim of rather too much importance, she was unable for some time to accomplish her object; at length the nephew of the chief, no longer able to bear the continual taunts of cowardice which she unceasingly heaped upon him, seized his gun and started for the Company's Fort on the river, about twenty miles distant. On arriving, he was courteously received by Mr. Black, the gentleman in charge of the Fort, who expressed great regret at the death of his old friend the chief. After presenting the Indian with something to eat, and giving him some tobacco, Mr. Black turned to leave the room, and while opening the door was shot from behind by his treacherous guest and immediately expired. The murderer succeeded in escaping from the Fort, but the tribe, who were warmly attached to Mr. Black, took his revenge upon themselves and hunted him down. This was done more to evince their high esteem for Mr. Black than from any sense of impropriety in the customary sacrifice.

I never heard any traditions amongst the Chinooks as to their former origin, although such traditions are common among the Indian tribes on the east side of the Rocky mountains. They do not believe in any future state of punishment, although in this world they suppose themselves exposed to the malicious designs of the Skōcoom or evil genius, to whom they attribute all their misfortunes and ill luck. The good spirit is called the *Hias Soch-a-li Ti-yah*, that is the Great High Chief from whom they obtain all that is good in this life, and to whose happy and peaceful hunting grounds they believe they shall all eventually go, to reside for ever in comfort and abundance.

The medicine men of the tribe are supposed to possess a mysterious influence with these two spirits, either for good or evil, and of course possess great power in the tribe. These medicine men form a secret society, the initiation into which is accompanied with great ceremony and much expense. I witnessed, whilst amongst them, the initiation of a canditate, which was as follows:—The canditate has to

prepare a feast for his friends and all who choose to partake of it, and make presents to the other medicine men. A lodge is prepared for him, which he enters, and remains alone for three days and nights, without food, whilst those already initiated keep dancing and singing round the lodge during the whole time. After this fast which is supposed to endue him with wonderful skill, he is taken up apparently lifeless and plunged into the nearest cold water, where they rub and wash him until he revives. This they call "washing the dead." As soon as he revives he runs into the woods, and soon returns dressed as a medicine man, in a costume which generally consists of the light down of the goose stuck all over the body and head with thick grease, and a mantle of friezed cedar bark.. With the medicine rattle in his hand he now collects all his property. blankets, shells and ornaments, and distributes the whole amongst his friends, trusting for his future support to the fees of his profession. The dancing and singing are still continued with great vigour during the division of the property, at the conclusion of which the whole party again sit down to feast, apparently with miraculous appetites, the quantity of food consumed being perfectly incredible.

I witnessed one day their mode of treatment of the sick whilst passing through a village. Hearing a horrible noise in one of the lodges, I entered it, and found an old woman supporting one of the handsomest girls of the tribe I had ever seen; cross-legged and naked in the middle of the room sat the medicine man with a wooden dish full of water before him, and twelve or fifteen other men sitting round the lodge. The object in view was to cure the girl of a disease affecting her side. As soon as my presence was noticed a space was cleared for me to sit down. The officiating medicine man appeared in a state of profuse pespiration from the exertions he had used, and soon took his seat amongst the rest as if quite exhausted ; a younger medicine man then took his place in front of the bowl and close beside the patient; throwing off his blanket he commenced singing and gesticulating in the most violent manner. whilst the others kept time by beating with little sticks on hollow wooden bowls and drums, singing continually. After exercising himself in this manner for about half an hour, until the pespiration ran in streams down his body, he darted suddenly upon the young woman catching hold of her side with his teeth and shaking her for a few minutes, as one dog does another in fighting. The patient seeming to suffer great agony. He then relinquished his hold, and cried out he had got it, at the same time holding his hands to his mouth, after which he plunged

them in the water, and pretended to hold down with great difficulty the disease which he had extracted lest it might spring out and return to its victim. At length having obtained the mastery over it, turning himself round to me in an exulting manner, he held something up between the finger and thumb of each hand, which had the appearance of a piece of cartilage, whereupon one of the Indians sharpened his knife and divided it in two, leaving one end in each hand. One of the pieces he threw into the water and the other into the fire, accompanying the action with a diabolical noise which none but a medicine man can make; after which he got up perfectly well satisfied with himself, although the poor patient seemed to me anything but relieved by the violent treatment she had undergone.

My principal object in travelling among the Indian tribes of the Far West was to obtain accurate sketches of their Chiefs, medicine men, &c., and representations of their most characteristic manners and customs, but it was only by great persuasion that I could induce the Indians to allow me to take their portraits. They had an undefined superstitious dread of losing something by the process, as though in taking their likeness something pertaining to themselves was carried off. The women, moreover, had the idea that the possessor of their picture would hold an unlimited influence over them. In one case I had taken the likeness of a woman at the Cowlitz river, and on my return about three months afterwards, I called at the lodge of Kisscox, the chief of the tribe, where I had been in the habit of visiting frequently, and had always been received with great kindness, but on this occasion I found him and his family unusually distant in their manner, and the children even running away from me and hiding; at last he asked me if I had not taken the likeness of a woman when last amongst them, I said I had, and mentioned her name, "Cawitchum," a dead silence ensued, nor could I get the slightest answer to my enquiries. Upon leaving the lodge I met a half-breed, who told me that Cawitchum was dead, and that I was supposed to be the cause of her death. The silence was occasioned by my having mentioned a dead person's name, which is considered disrespectful to the deceased, and unlucky. I immediatly left the neighbourhood, well knowing the danger that would result from my meeting with any of her relations.

Upon trying to persuade another Indian to sit for his likeness he asked me repeatedly if it would not endanger his life. Being very much in want of tobacco he at length appeared convinced by my assurances that it could do him no harm, but when the picture was

finished he held up the tobacco and said it was a small piece to risk his life for. I asked another Indian while he was sitting in his lodge, surrounded by his eight wives, for the same favor, but the ladies all commenced violently jabbering at me until I was glad to get off: he apparently was much gratified at the interest which his wives took in his welfare. I however met him alone some short time afterwards and got him to consent, with my usual bribe, a piece of tobacco. I could relate numerous instances of this superstitious dread of portrait painting, but the foregoing sufficiently illustrates the general feeling on the subject.

I shall conclude this paper by relating a legend told me by an old Indian while paddling in a canoe past an isolated rock on the shores of the Pacific, as it gives an idea of the general character of the legends on the coast, which are however very few, and generally told in an unconnected and confused manner. The rock with which the following Indian legend is associated. rises to a height of between six and seven feet above the water, and measures little more than four feet in circumference. I could not observe any very special peculiarity in the formation of this rock while paddling past it in a canoe; and, at least from the points of observation presented to my eye, no resemblance to the human figure—such as the conclusion of the legend might lead us to anticipate,—appeared to be traceable. Standing, however, as this rock does, entirely isolated, and without any other visible for miles around, it has naturally become an object of special note to the Indians, and is not uncalculated, from its solitary position, to be made the scene of some of the fanciful creations of their superstitous credulity.

"It is many moons since a Nasquawley family lived near this spot. It consisted of a widow with four sons; one of them was by her first husband, the other three by her second. The three younger sons treated their elder brother with great unkindness, refusing him any share of the produce of their hunting and fishing; he, on the contrary, wishing to conciliate them, always gave them a share of his spoils. He in fact was a great medicine man, although this was unknown to them, and being tired of their harsh treatment, which no kindness on his part seemed to soften, he at length resolved to retaliate. He accordingly one day entered the lodge where they were feasting and told them that there was a large seal a short distance off. They instantly seized their spears and started in the direction he pointed out, and coming up to the animal the eldest drove his spear into it. This seal was 'a great medicine,' a familiar of the

elder brother who had himself created it for the occasion. The foremost of them had no sooner driven in his spear than he found it impossible to disengage his hand from the handle or to draw it out; the two others drove in their spears and with the like effect. The seal now took to the water, dragging them after it, and swam far out to sea. Having travelled on for many miles they saw an island in the distance, towards which the seal made ; on nearing the shore they found that they could, for the first time, remove their hands from their spears; they accordingly landed, and supposing themselves in some enemies' country, they hid themselves in a clump of bushes from observation. While lying concealed they saw a diminutive canoe coming round a point in the distance, paddled by a very little man, who, when he came opposite to where they were, anchored his boat with a stone attached to a long line, without perceiving them. He now sprang over the side, and diving down, remained a long time under water, at length he rose to the surface and brought with him a large fish, which he threw into the boat; this he repeated several times, each time looking in to count the fish he had caught. The three brothers being very hungry, one of them offered to swim out while the little man was under water and steal one of the fish; this he safely accomplished before the return of the fisherman, but the little fellow no sooner returned with another fish than he discovered that one of those already caught was missing, and stretching out his hand he passed it slowly along the horizon, until it pointed directly to their place of concealment. He now drew up his anchor and paddled to the shore, and immediately discovered the three brothers ; and being as miraculously strong as he was diminutive, he tied their hands and feet together and throwing them into his canoe, jumped in and paddled back in the direction from whence he had come. Having rounded the distant point where they first descried him, they came to a village inhabited by a race of people as small as their captor, their houses, boats, and utensils being all in proportion to themselves. The three brothers were taken out and thrown bound as they were into a lodge, while a council was convened to decide upon their fate. During the sitting of the council an immense flock of birds resembling geese, but much larger, pounced down upon the inhabitants and commenced a violent attack. These birds had the power of throwing their sharp quills like the porcupine, and though the little warriors fought with great valour they soon became covered with the piercing darts, and all sunk insensible on the ground; when all resistance had ceased the birds took to flight and disap-

peared. The three brothers had witnessed the conflict from their place of confinement, and with much labour had succeeded in releasing themselves from their bonds, when they went to the battle ground and commenced pulling the quills from the apparently lifeless bodies, but no sooner had they done this than all instantly returned to consciousness. When all of them had become well again they wished to express their gratitude to their preservers and they offered to grant whatsoever they should desire. The three brothers therefore requested to be sent back to their own country. A council was accordingly called to decide upon the easiest mode of doing so, and they eventually determined upon employing a whale for the purpose. The three brothers were then seated upon the back of the monster and proceeded in the direction of Nasquawley : however, when they had reached about half way the whale began to think what a fool he was for carrying them instead of turning them into porpoises and letting them swim home themselves. Now the whale being a "Soch-a-li-Tiyah" or great spirit—that is the highest of all animal spirits—but of course inferior to the "Hias Soch-a-li Tiyah," who is the Great Spirit over all things, was able to do this at will, and he accordingly tnrned the three brothers into porpoises. This therefore is the way that the porpoises first came into existence, and accounts for their being constantly at war with the seals, one of which species was the cause of their first misfortunes. After the three brothers had so strangely disappeared their mother came down to the beach and remained there for days watching for their return and bewailing their absence with tears. While thus engaged one day the whale happened to pass by and taking pity on her distress he turned her into that stone."

NOTE ON THE OXALATE OF MANGANESE.

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Read before the Canadian Institute, December 20th, 1856.

In Gmelin's Handbuch, Vol. IV., the oxalate of the protoxide of manganese is described as having been obtained by Graham, combined with 5 equivalents (24,16 per cent.) of water, by precipitation

of a solution of one part of manganese-salt in 100 of water, by means of oxalate of potassa; and this compound is stated to lose no water at 212°.F. Nothing is said with regard to the amount of water in the precipitate obtained from concentrated manganese solutions by oxalic acid.

There is evidently some error in the above statement, for the formula MnO, C^2O^3+5 HO requires 38,60 per cent. of water, and Mn O, C^2O^3+3 HO requires 27.39.

In the 89th volume of the Annalen der Chemie and Pharmacie, Hausmann and Löwenthal give an analysis of the oxalate obtained by acting on freshly precipitated carbonate of manganese with oxalic acid, from which they deduce the formula Mn O, C^2O^3+2 HO, for the salt dried at 212°. F.

The following experiments were made for the purpose of explaining the discrepancy.

Strong solutions of sulphate of manganese were precipitated by saturated solutions of oxalic acid, a granular white precipitate was obtained in both cases, which did not lose water at 212°. F. I. and II.

Similar solutions were mixed when boiling. III.

Sulphate of manganese was dissolved in 30 parts of water, and oxalic acid added, a light pinkish crystalline precipitate was formed after a time, which, in the course of a few days, changed into a perfectly white granular powder. IV.

Sulphate of manganese was dissolved in 30 parts of water, and a solution of oxalate of potassa added, a light pinkish crystalline precipitate gradually formed, having the appearance and lightness of benzoic acid, it absorbed and retained water like a sponge, and remained unchanged in the air at ordinary temperatures, but became perfectly white at 212°. F. V.

Sulphate of manganese was dissolved in 100 parts of water, and oxalate of potassa added; the same pink salt was obtained. VI. This should be the compound described by Graham, with 5 HO.

WHITE SALT.

I.	1.391	grms.	gave	0.5890	Mn^3O^4	= 39.38	per cent.	MnO
II.	1.292	"	"	0.5566	"	= 40.07	"	"
III.	1.717	"	"	0.7510	"	= 40.68	"	"
IV.	1.295	"	"	0.5545	"	= 39.83	"	"
					Mean	39.99.		

The formula MnO, C^2O^3+2 HO requires 39.72.

PINK SALT.

V.	1.0575	grms. gave	0.418	Mn^3O^4	= 36.77	per cent.	MnO
	1.3700	" "	0.536	"	= 36.79	"	"
VI.	1.4395	" "	0.567	"	= 36.64	"	"
	1.5300	" "	0.597	"	= 36,39	"	"
				Mean	36.62.		

1.5300 heated to 212°.F. lost 0.134 HO = 8.75 per cent. HO, and became perfectly white.

The formula MnO, C^2O^3+3 HO requires 36.09 per cent. MnO and one equivalent of water would = 9.09 per cent.

The red oxide of manganese is obtained by heating this salt, in a crystalline form ; the complete conversion of the protoxide into the red oxide is only effected after a rather long roasting.

Burin du Buisson is of opinion that pure salts of the protoxide of manganese are colourless when in an anhydrous state, but reddish when hydrated, while Reithner and others ascribe the red colour to the presence of a salt of the sesquioxide. The pink colour of the above hydrate can scarcely be owing to the latter cause, inasmuch as the salt is produced both by oxalic acid and by oxalate of potash; and the salt with 2 HO is generally obtained perfectly white. (This salt is described by Liebig as having a tinge of pink, but in my experiments it was always white.) The pink crystallized salt changes in a warm atmosphere, even when kept in a close vessel, into the white compound, evolving water.

The oxalate dissolves readily in a hot solution of oxalate of ammonia, and crystalline compounds can be obtained as already described by Winkelblech: these crystalline crusts, however, seem to vary much in their composition, and are probably combinations of the true double salt with variable proportions of oxalate of ammonia, similar to the magnesia compounds lately described by Souchay and Leussen.

REVIEWS.

Canada at the Universal Exhibition of 1855.—Printed by order of the Legislative Assembly. Toronto: John Lovell, 1856.

The success which attended the Canadian exhibition at London, in 1851, naturally led to the expectation that no efforts would be spared to present at Paris, in 1855, a correct representation of the Natural Productions and Industry of this vast Province.

It was a triumph of no common order to receive a public acknowledgement of "the superiority of the Canadian collection at London, as far as the mineral kingdom was concerned, to all countries that forwarded their products to the Exhibition," and the "very remarkable specimens of the chief varieties of Canadian timber," together "with the fine supply of wheats, every sample of more than average excellence," so favorably noticed by the jurors, inspired the hope that Canada would be fairly represented and appreciated at the great Paris Exhibition, in 1855. Nor has this hope been disappointed, when the vast distance which separated us from the scene of rivalry and display is considered, and the facilities which wealth, leisure, and position, conferred on the majority of European Exhibitors.

With few exceptions, it could scarcely be a subject of personal pecuniary interest to the farmers and manufacturers of this country to send the results of their industry or skill to compete with ages of experience in Europe. Even the products of our forests, though if known in all their variety and excellence beyond our borders, they would doubtless create a profitable market, yet, if their representation had been altogether left to the unremunerated zeal of private contributors, it is scarcely probable that even they would have been fairly represented. Hence the Provincial Committee, appointed to secure a fitting representation of the products of this Country at the Paris Exhibition, arrived at the conclusion, that any attempt to induce *voluntary* efforts by local fairs, such as those which were held at Toronto and Montreal previous to the Exhibition of 1851, would be fruitless, and that it would be absolutely necessary that the Provincial Committee should have the authority to purchase such articles as they deemed it expedient to transmit to Paris.

In accordance with this suggestion the Canadian Government appropriated a sufficient sum to cover all the expenses of the transit and ultimate purchase of the articles sent. It was further suggested by the Executive Committee that every effort should be made to secure a satisfactory representation of the great staple products of Canada—Minerals, Agricultural Products, and Timber—so successfully represented at London in 1851; and also, that the manufactures of the country should be exhibited in their progressive stages up to the highest point of perfection. Local exhibitions were held at Toronto and Montreal, and selections made as in 1851, for transmission to Paris. Hence it appears that no effort was spared to have Canada properly represented, and with what success we are informed by Mr. Taché's Report of "Canada at the Universal Exhibition of 1855."

We are told that the display of the products of Mines, Forests, and Agriculture "was truly magnificent," and that the premiums obtained were such as to give full satisfaction to all who were interested in exhibiting the natural resources of Canada to the greatest advantage. The samples of agricultural product were very fine, and included every variety of the cereals cultivated in this country. Fifty-six different kinds of minerals are enumerated in the catalogue of articles sent, and sixty-four kinds of woods, together with numerous models in wax of the vegetables and fruits grown in the Province. The Executive Council close their report, which forms the first part of Mr. Taché's volume, "with the consoling reflection that the most complete success has crowned the undertaking, for the due carrying out of which, the country has manifested such earnest solicitude."

The two special Commissioners, Sir W. Logan and Mr. Taché, divided the duties of their office, the former undertaking the arrangement of the exhibition; the latter, the diffusion of information respecting Canada throughout Europe, and of the entire exhibition throughout Canada. These efforts resulted in attracting a larger share of public attention to Canada, in proportion to its population, than to any other country; and, Count Jaubert, in his work entitled "La Botanique à l'exposition universelle de 1855," reproachfully says, "now we can form an estimate of the value of those few arpents of snow ceded to England with such culpable carelessness by the Government of Louis XV."

The testimony of many distinguished men may be adduced to shew that the most complete success crowned the efforts made by this country at the Universal Exhibition, and in one history of that wonderful pageant, Mr. Robin, the author, remarks: "the efforts made by Canada, that old French Colony, to make a suitable appearance at the great Exhibition of 1855, efforts which have resulted, moreover, in the most complete success, coupled with the undoubted importance of that fine country, whose future cannot be otherwise than brilliant, render it a duty on our part to devote to it a distinct chapter." Canada obtained one grand medal of honour (Sir W. Logan,) and is the only colony which secured that distinction—one medal of honour for the collection of woods and grains, thirteen silver medals, thirty bronze medals, and forty-eight 'honorable mentions,'—making altogether ninety-three prizes carried off at Paris, while at London the number of prizes awarded to this country amounted only to sixty-three. Mr. Romain's Steam Cultivator was not exhibited, it having been purchased and withdrawn from the exhibition by the celebrated

Agricultural Machine makers, Crosskill & Co., and is now designated as "Romain's Canadian Steam Cultivator."

Mr. Taché published in Paris his prize essay entitled "Esquisse sur la Canada consideré sous le point de vue économiste,"—and in the report before us a translation of this little work is given. He also published a descriptive catalogue of the productions of Canada, exhibited in Paris in 1855, and at the end of each enumeration of articles embraced in the different classes, he gives their prices in this country, and appends remarks as to their distribution, commercial importance, &c. With reference to our progress in mining industry, we find that the exportations of metals from our mines was valued at £8,350 in 1852, and £74,000 in 1854. Attention is directed to the value of the Tamarack, as a serviceable wood, rapidly growing into favour in Europe. The oil of the black porpoise, *Delphinus minor*, is particularly noticed, on account of its remarkable property of retaining its fluidity at a very low temperature. Porpoise leather is altogether an article of Canadian manufacture, and possesses many valuable peculiarities. Birds'-eye maple was found to be excluded from general use in the Paris cabinet manufactories, on account of its price, and Mr. Taché very appropriately mentions the fact that it is used for fuel in Canada, and ought to be supplied at a price little above that of the commonest woods.

We are next furnished with "Observations on the Exhibition," which have already been published in the form of correspondence, addressed, during the exhibition, to a portion of the French Press of Lower Canada; these are republished in the Report, by order of the House of Assembly. Among many facts of interest to Canadians, contained in these instructive and attractive letters, we are told that the total area of the Crystal Palace at London, in 1851, was about 800,000 square feet—that of the Palace of Industry and its Annexe at Paris, exclusive of the Palace used for the exhibition of Fine Arts, 1,200,000 feet. The number of exhibitors at London was 14,840, at Paris 20,839.

Bearing in mind the depopulated condition of many of our Canadian rivers, which once swarmed with fish, Mr. Taché notices the illustrations of the new art of Pisciculture, and the specimens of young fry and spawn exhibited by Mr. Mallet, "who rears pike, carp, eels, &c., as other people do puppies." Various plans of fish-ways up mill dams are eminently suggestive, and ought to be introduced on every Canadian river where a dam is constructed, tending to oppose the upward progress of the fish in spawning time, and thus to depopulate our rivers.

Mr. Letailleur's success in replacing rare furs by sheep skins prepared and dyed in various ways and colours, appears likely to commend itself to Canadian manufacturers.

Comparing the Canadian part of the Exhibition with its European rivals, Mr. Taché says:

"In the first class, embracing all that relates to the extraction of mineral substances, and to the minerals themselves, we were among the last, and far behind most countries, in regard to metallurgical operations, for the very simple reason that we are deficient in the population and capital which carry on, and still more deficient in the men of science, who in France, England, Austria, Prussia, Belgium, and other countries, direct and enlighten the labors of the mine. But if we proceed to an examination of the minerals in their natural state, our section at once assumed the first rank, and no country was in a condition to compete with us for a moment, either in the aggregate or the details of the department. The class of Canadian minerals was the most complete, and had the advantage of displaying at a glance to the learned observer the geological configuration of the country, with reference to the industrial results which it may yield. For this success, which is a mere repetition of that obtained at London in 1851, Canada is indebted entirely to the geological commissioners; and this shews to demonstration, the necessity of continuing the labors of that commission on a more liberal scale. We possess in the bosom of the earth the untouched riches, which in England have been the main element of industrial and commercial greatness; but the conditions of progress towards that greatness, are the light of science, and extensive enterprise. Mining operations cannot be profitably conducted on a small scale.

When we reflect that the iron which abounds in Canada is nearly of the same quality as that of Sweden, that it is found in places, surrounded by immense forests, and that, we have at hand the stone, sand, and other matters which are necessary for the smelting, moulding, and casting of the metal, we may well wonder that every year we import from England, Sweden, and the United States, manufactured iron to the amount of more than £1,000,000. But, we must again observe, success attends such enterprises, only when undertaken on a grand scale, whatever the abundance of the raw material. The working of an iron mine is not for limited means, nor to be carried on on a petty scale. A cheap market must be a full market. In Europe blast furnaces are now built, capable of smelting 80,000 lbs. per diem. The want of coke in Canada, be it observed, does not oppose an obstacle to the successful prosecution of iron-works. Ours is a country of rich forests 270,000 square miles in extent. Sweden smelts her iron with charcoal only, and sells it to England for a paying price; the English convert it into steel and send it to other countries. Other European countries use charcoal, notwithstanding the general scarcity and dearness of wood in Europe."

It appears also that "no country could compete with us in the show of woods, and particularly of the kinds used in ship-building, including in the estimate all the various species. In this class are embraced, moreover, all the products of the chase and the fisheries, in which departments the Gulf, and the vast territories of the Saguenay and the North-West, place us beyond competition, if not as producers,

at least as proprietors of the finest field for production, in the whole world." The hints derived from an inspection of the raw material used by cabinet makers and carpenters among European nations, suggest very extensive alterations in the mode of getting out timber in our Canadian Forests, which deserve special notice.

"In lumbering, as the making of timber is termed in Canada, just that amount of intelligence is brought into action, which is required for the squaring of the logs, and the sawing of them into the planks of commerce. None of that skill of woodcraft is exercised which turns to the best and most profitable account the various species, by attending to their several degrees of adaptation to the mechanic arts, and to the preparation to be expended on them to make them fit for market. As before observed, two things only are known, square timber and the plank three inches thick. A more recondite study of the application of timber to the mechanic arts, would instruct us in the fact, that there are conditions of length, girth, and diameter required in those arts, by the influence of which the square log of 50 feet long by 20 inches square, and plank of 12 feet by 10 inches, lose their intrinsic value as compared with that higher value which is derivable from compliance with those conditions. How many are the trees left to rot in the forest because they are not reducible to a saw log of the standard measure, or a square stick of the required dimensions: which, trimmed to another form, would in other markets bear a greater value, though diminished in volume.

Of more than sixty principal species of timber which we possess, we make profitable use of scarcely ten, the rest are left to absolute decay. In Europe the birds'-eye maple is considered as equal to the most precious of the woods used in cabinet-work. It is indeed hardly attainable, and when found, it bears a higher price than mahogany. From this cause arises the dearness of all the articles made of maple in Parisian cabinet-work, the finest in the world."

Our agricultural productions when compared with those of other countries placed us on a level with the foremost: "our grain won the admiration of all who saw it." The absence of Hemp, Flax and Tobacco, however, was particularly noticed in the Canadian section, and our climate and soil were thought to furnish very favourable conditions for the cultivation of those valuable articles. It is not perhaps generally known by those who expressed surprise at the absence of Tobacco, that the late spring frosts to which our climate is subject, render the growth of Tobacco an expensive and very hazardous experiment. Where labour is very dear and sowing time very transient, it becomes a mere matter of calculation how far the growth of Tobacco may be made remunerative. It has often succeeded admirably in the western peninsula, but the occurrence of late frosts has not unfrequently destroyed the crops over wide areas and discouraged the cultivation of this important narcotic. Hemp and Flax give better promise of remunerative returns, and will no doubt soon form an important article of Canadian production.

Our castings did not meet with much favour, and the reasons may be drawn from the following observations by Mr. Taché :

"What lightness is found in the railings, the iron seats, &c., of the English manufacture of the Coalbrookdale Company in Shropshire, and how cheap also are the articles? The reason is plain, the purchaser has not to pay for a lot of useless iron."

"What elegance there is in the stoves and other articles of French manufacture, from the blast furnaces of the Marquis de Vogué of France? These designs of hunting and historical scenes are bas-reliefs of art, and the articles are not dearer on that account, because the material is not wasted; and as to the casting, the beautiful costs no more than the most deformed piece that ever was moulded. This is now generally understood; and in England where art is less perfect than in France and Belgium, the proprietors of foundries endeavour to procure artists from those two countries. A French sculptor, M. Geneste, is at this moment, in the receipt of a salary of £2000 per annum from an English manufacturer."

"The art of combining the useful with the agreeable is the climax of material progress. The study of the beautiful in art, is, to the intellectual man, what the study of truth is to his moral existence."

From many admirable inventions and applications which commend themselves to the attention of Canadians, and which are specially noticed with that object by Mr. Taché, we select some which appear likely to meet with adoption and favour. A smoke consuming coal grate, which is in the shape of an endless chain, and uncoils as the coal is consumed, thus combining advantages of health and economy. A machine by M. Chevalier, which by means of an endless steel wire adapted to pullies, saws with the greatest regularity the hardest stone, as quartz, granite, and even crystal. Two machines by M. Sautreuil, of Léchamp; one for preparing flooring boards by a single stroke, the other a planing machine, for smoothing timber for building purposes, on four sides at once. Messrs. Irey and Roly, of Paris, have introduced caoutchouc as a material for springs in all their machines. In the manufacture of chemical matches, for the production of an instantaneous light, Austria employs not less than 20,000 persons, and the highest price for round matches is only one penny per thousand. Mr. Quinti, of Vienna, showed how by interrupting the current by non-conductors, two communications may be transmitted simultaneously in opposite directions by the same wire. The preservation of food by the perfect exclusion of external air is easily accomplished by the immersion of game, or other meats, in a warm solution of gelatine. The celebrated Russia Leather is tanned with the decoction of willow bark, and impregnated with an oil extracted from the bark of the bouleau. A curious result of the artificial preparation of a valuable pigment is shown in the manufacture of Ultramarine. The nat-

tural mineral used to cost £75 per pound, and no more than four pounds were used in Europe in a year; now Europe manufactures and consumes 5,000,000 lbs. per annum, at a cost of one shilling per pound. One of the active principles in opium having been artificially produced there is no doubt but that quinine and other valuable medicinal agents will be prepared on a large and cheap scale in the laboratory. Vegetables may be prepared, for keeping by exposure to hot air and powerful compression, so that 1200 lbs. of dried vegetables may be packed into a space little exceeding a cube yard; but 1200 lbs. of dried vegetables represent 8000 lbs. in their natural condition, which would require nearly forty cubic yards to contain them. The allied armies in the Crimea were provided with vegetables thus prepared to the extent of 42,000,000 rations. M. Coignet, of St Denis, exhibited a stone consisting of coal ashes and quick lime; or of sand, small shingle and lime: it is run like grouting. We may here observe that this method of building has long been practised in Amerca and even in the neighbourhood of Toronto.

It is unnecessary to advert to the "Sketch of the Geology of Canada," by Sir W. Logan and Mr. Hunt, or to the beautiful geological map accompanying the sketch, which are together appended to Mr. Taché's report, as these admirable and instructive illustrations of our mineral wealth have already been noticed in the Canadian Journal (new series, vol. i, p. 379.) We shall draw this brief summary of Mr. Taché's report to a close with a quotation from M. Fresca's work on the Exhibition; deeming it more satisfactory to receive and accept the testimony of a distinguished foreigner, than to express the favourable opinions of our great success at Paris which the perusal of Mr. Taché's report create.

"Canada," says M. Fresca, "is a land of hope not likely to be disapointed. Active, intelligent, and enterprising beyond all other nations, which equally abound in the elements of industral production, she claims and demands our attention."

H. Y. H.

The Tenth Annual Report of the Smithsonian Institution for the year 1855. Washington, 1856.

To such of our readers as are unacquainted with the origin and operation of this splendid establishment, the following brief notice may not be unacceptable:

Hugh Smithson, from whom the institution derives its name, was a relative of the Duke of Northumberland. He was much devoted to physical science, and at Oxford, where he graduated, enjoyed the reputation of being the best chemist in the university. He was a cosmopolitan in his views, and used to express himself to the effect that the man of science belongs exclusively to no country; that the world is his country and all men are his countrymen. It was, it is believed, at one time his intention to leave his property to the Royal Society of London, for the promotion of science, but in consequence of a misunderstanding with the council of the society, he changed his mind and left it to his nephew, and, in case of the death of that relation without issue, to the United States of America, to found the institution which now bears his name.

In 1829 Smithson died, leaving his fortune, £120,000, in case of the death of his nephew, to whom it was first bequeathed, to found at Washington, under the name of the Smithsonian Institution, an establishment for the *increase* and *diffusion* of knowledge among men.

In 1838, the nephew having died, the money was paid over by the English Court of Chancery to the Agent appointed by the Government of the United States; and eight years afterwards, in 1846, an Act was passed through Congress for the establishment of the Smithsonian Institution.

By this Act the immediate government of the institution devolved upon the Board of Regents consisting of the following 15 members:

The Vice-President of the United States, the Chief Justice of the Supreme Court, the Mayor of the City of Washington, ex-officio; three members of the Senate, to be appointed by the President thereof; three members of the House of Representatives, appointed by the Speaker; six persons chosen from the citizens at large by joint resolution of the Senate and House, two of whom shall be members of the National Institute, and the other four inhabitants of states, and no two from the same state.

With a view of carrying the wishes of the testator into effect the Secretary, Professor Henry, was empowered to draw up a programme for the organization of the institution, which was presented in his first Annual Report to the Board of Regents and adopted by them in 1847.

As this programme is presented in the report before us we are enabled to give some extracts which serve to exhibit the principles

that guide the governing body, as well as the mode of carrying the objects of the institution into effect.

"General considerations which should serve as a guide in adopting a plan of organization.

(1). Will of Smithson. The property is bequeathed to the United States of America to found at Washington, under the name of the SMITHSONIAN INSTITUTION, an establishment for the increase and diffusion of knowledge among men.

(2). The bequest is for the benefit of mankind. The Government of the United States is merely a trustee to carry out the design of the testator.

(3). The institution is not a national establishment, as is frequently supposed, but the establishment of an individual, and is to bear and perpetuate his name.

(4). The objects of this institution are, 1st., to increase, and 2nd, to diffuse, knowledge among men.

(5). These two objects should not be confounded with one another. The first is to enlarge the existing stock of knowledge by the addition of new truths; and the second, to disseminate knowledge, thus increased, among men.

(6). The will makes no restriction in favor of any particular kind of knowledge; hence all branches are entitled to a share of attention.

(13). It should be recollected that mankind in general are to be benefited by the bequest, and that, therefore, all unnecessary expenditure on local objects would be a perversion of the trust.

(14). Besides the forgoing considerations, deduced immediately from the will of Smithson, regard must be had to certain requirements of the Act of Congress establishing the institution. These are, a library, a museum, and a gallery of art, with a building on a liberal scale to contain them."

In order to carry out the two leading objects of the will of Mr. Smithson, the *increase*, namely, and the *diffusion* of knowledge, the same report recommends the following plans:

To *increase* knowledge one means proposed is to stimulate men of talent to make original researches by offering suitable rewards for memoirs containing new truths. The memoirs thus obtained are to be published in a series of volumes, and entitled Smithsonian Contributions to Knowledge.

Among the various objects of research named for which pecuniary appropriations may be made are included, a system of meteorological observations for solving the problem of American storms; Explorations in Natural History and Geology; Magnetic and Topographical Surveys; the solution of various experimental problems; and Statistical, Historical and Ethnological enquiries.

To promote the *diffusion* of knowledge the two leading means suggested are the publication of periodical reports on the progress of different branches of knowledge, and the publication occasionally of separate treatises.

For the preparation of these reports it is proposed that men

eminent in the respective branches be employed, that they be furnished with journals and other necessary publications, and that they be paid a certain sum for their labors.

In virtue of the Act of Congress, the Secretary and his assistants, during the session of Congress, will be required to illustrate new discoveries in science and to exhibit new objects of art; distinguished individuals will also be invited to give lectures on subjects of general interest.

On the occasion of the meeting of the Regents in 1847, it was resolved to divide the income into two equal parts; one to be appropriated to increase and diffuse knowledge agreeably to the scheme above given; and the other part to be appropriated to the formation of a library and a collection of objects of nature and of art.

This resolution was, however, rescinded at the meeting of January, 1855, when it was determined that

"The annual appropriations should be apportioned specially among the different objects and operations of the institution, in such manner as might, in the judgment of the Regents, be necessary and proper for each, according to its intrinsic importance, and a compliance in good faith with the law."

Admirably adapted as the foregoing scheme would seem to be for carrying out *bonâ fide*, the design of the founder, efforts have been made by some persons to divert from their legitimate channel the funds destined for cosmopolitan purposes, and to expend them on objects of a comparatively local character The good sense and honorable feeling of the nation have, however, triumphed, and will, it is hoped, insure the permanence of the institution on its present footing. The mode of procedure adopted by the Regents in conducting the affairs of the institution having been brought under the notice of Congress in 1855, the matter was referred to a Special Committee of the House of Representatives and to the Judiciary Committee of the Senate. In reporting subsequently on the matter the Judiciary Committee unanimously approved of the acts of the Regents in construing the law of Congress, in interpreting the will of Smithson, and in what they had done in the way of increasing and diffusing knowledge among men.

In the verdict of the Judiciary Committee we find the following language:

(Referring to the legacy). "It is not bequeathed to the United States to be used for their own benefit and advantage only, but in trust to apply to the increase and diffusion of knowledge among mankind generally, so that other men and other nations might share in its advantages as well as ourselves."

Again, in reference to the proposed application of the funds to the formation of a library, the Judiciary Committee go on to say:

"Such an application of the funds could hardly be regarded as a faithful execution of the trust; for the collection of an immense library at Washington would certainly not tend to increase or diffuse knowledge in any other country, not even among the countrymen of the testator; very few even of the citizens of the United States would receive any benefit from it.

"This is the construction which the Regents have given to the Acts of Congress, and in the opinion of the committee, it is the true one, and, acting under it, they have erected a commodious building, given their attention to all the branches of science mentioned in the law, to the full extent of the means afforded by the fund of the institution, and have been forming a library of choice and valuable books, amounting already to more than fifteen thousand volumes. The books are, for the most part, precisely of the character calculated to carry out the intentions of the donor of the fund, and of the Act of Congress. They are chiefly composed of works published by or under the auspices of the numerous institutions of Europe which are engaged in scientific pursuits, giving an account of their respective researches and of new discoveries whenever they are made. These works are sent to the Smithsonian Institution in return for the publications of this institution which are transmitted to the learned societies and establishments abroad. The library thus formed, and the means by which it is accomplished, are peculiarly calculated to attain the objects for which the munificent legacy was given in trust to the United States. The publication of the results of scientific researches made by the institution is calculated to stimulate American genius, and at the same time enable it to bring before the public the fruits of its labors. And the transmission of these publications to the learned societies in Europe, and receiving in return the fruits of similar researches made by them, gives to each the benefit of the increase of knowledge which either may obtain, and at the same time diffuses it throughout the civilized world. The library thus formed will contain books suitable to the present state of scientific knowledge, and will keep pace with its advance; and it is certainly far superior to a vast collection of expensive works, most of which may be found in any public library, and many of which are mere objects of curiosity or amusement, and seldom, if ever, opened by any one engaged in the pursuit of science."

The Judiciary Committee conclude their report in the following terms:

"From the views entertained by the committee, after an impartial examination of the proceedings referred to, the committee have adopted the language of the resolution, 'that no action of the Senate is necessary and proper in regard to the Smithsonian Institution; *and this is the unanimous opinion of the committee.*'"

Having then briefly considered the origin, proposed objects and mode of action of this magnificent establishment, it remains for us to examine from the report for the year 1855 how far the proposed objects are in course of accomplishment.

The following are the principal contents of the report of the Regents for 1855;

The Report of the Secretary to the Board of Regents; the Report of the Assistant Secretary and Curator; Reports of sub-committees relative to expenditure; Journals of meetings of the board; outlines of several lectures delivered in the rooms of the institution; directions to meteorological observers and various reports and suggestions relative to meteorological observations; correspondence relative to Ethnological and Topographical researches; and, finally, a long and able report on the present condition of the science of galvanism, by Professor Müller, of Freiburg, and translated from the German by Mr. Baker, of the Coast Survey.

SECRETARY'S REPORT.

Among the memoirs which, in accordance with the announcement in the Secretary's Report, form the eighth volume of the Smithsonian Contributions are the following: along with others, by Major B. Alvord, and Dr. Joseph Jones; and a record of Auroral phenomena, by P. Force:

(1). On the progress of information and opinion respecting the archæology of the United States, by Samuel F. Haven, Librarian of the American Antiquarian Society.

(2). A paper on the recent secular period of the Aurora Borealis, by Professor Olmstead.

One useful function of the Smithsonian Institution is that of effecting literary and scientific exchanges between individuals and societies. The extent of their operations in this department may be judged of by the fact that in the year 1855, 8585 packages for distribution passed through the hands of the institution.

The Smithsonian agency is not confined to the transmission of works from the United States, but is extended to those of Canada and Central and South America, and its foreign relations embrace every part of the civilized world. It brings into friendly correspondence cultivators of original research the most widely separated, and emphatically realizes the idea of Smithson, that "the man of science is of no country;" that "the world is his country, and all mankind his countrymen."

The system of exchange has found favor with foreign governments, and the Smithsonian packages are now admitted into all parts to which they are sent, without detention and free of duty.

METEOROLOGY.

Since the publication of the former report an arrangement has been made with the Commissioner of Patents, by which the system of Meteorological observations established under the direction of the institution will be extended, and the results published more fully than the Smithsonian income will allow.

With respect to the complaints that have been made that but few of the materials collected have been published, the report remarks,

"It is more important that the information should be reliable than that it should be quickly published," and "what may be lost by delay is more than compensated by the precision and value of the results.

The reduction of the meteorological observations have been continued by Professor Coffin. He has completed the discussion of all the records for 1854, and those of 1855 as far as they have been sent in.

LIBRARY.

It is the present intention of the Regents to render the Smithsonian library the most extensive and perfect collection of Transactions and scientific works in this country, and this it will be enabled to accomplish by means of its exchanges, which will furnish it with all the current journals and publications of societies. The Institution has already more complete sets of transactions of learned societies than are to be found in the oldest libraries in the United States.

MUSEUM.

It is no part of the plan of the institution to form a Museum merely to gratify the curiosity of the casual visitor to the Smithsonian building, but it is the design to form complete collections in certain branches, which may serve to facilitate the study and increase the knowledge of natural history and geology.

With respect to the condition of the Museum, the report asserts that no collection of animals in the United States, nor indeed in the world, can even now pretend to rival the richness of this Museum in specimens which tend to illustrate the natural history of North America.

In the report of Professor Baird, the Assistant-Secretary, many details are given relative to the additions to the Museum. These additions have been made in great measure through the agency of the government exploring expeditions, and partly also through that of individuals under the orders of the institution.

LECTURES.

The titles of the lectures, of which the substance is given in the volume before us, are as follows:

(2). A course of lectures on Marine Algæ, by W. H. Harvey, of the University of Dublin.

(2). Natural History as applied to farming and gardening, by Rev. J. G. Morris of Baltimore.

(3). Insect instincts and transformations, by the same.

(4). On oxygen and its combinations, by Professor Chase, of Brown University

(5). On meteoric stones, by Lawrence Smith, of the University of Louisville, Ky

(6). On planetary disturbances, by Professor Snell, of Amherst College.

The first lecture, by the Rev. Mr. Morris, on natural history as applied to farming and gardening, will be read with peculiar interest at the present time, when attention has been so much attracted to insect ravages on the corn crops. One practical evil, spoken of by the lecturer, arising from ignorance of the habits of insects, is that farmers and gardeners, by destroying one class of noxious animals,

expose themselves to the ravages of more numerous and destructive creatures, whose numbers, the first, if suffered to live, would have kept within bounds. Speaking of one kind of moth, peculiarly hurtful to the vineyards in France, and of what may be done to check the evil if the habits of the creature be understood, he states that in twelve days from twenty to thirty women and children destroyed upwards of forty millions of eggs that would have been hatched in a few days. From the sketch of this lecture given, we are led greatly to regret that the abstract should not have had a greater space allotted to it than five pages.

LECTURE ON METEORIC STONES, BY DR. J. L. SMITH.

The lecturer distinctly maintains the lunar organ of meteoric stones. The discussion which, even in its abridged form, occupies twenty-four pages, is concluded in the following terms :

" To sum up the theory of the lunar origin of meteorites, it may be stated that " the moon is the only large body in space of which we have any knowledge, " possessing the requisite conditions demanded by the physical and chemical pro- " perties of meteorites ; and that they have been thrown off by volcanic action, " (doubtless long since extinct) or some other disruptive force, and encountering " no gaseous medium of residence, reached such a distance as that the moon ex- " ercised no longer a preponderating attraction, the detached fragment possessing " an orbital motion and an orbital velocity, which it had in common with all parts of " the moon, but now more or less modified by the projectile force and new condi- " tion of attraction in which it was placed with reference to the earth, acquired " an independent orbit more or less elliptical. This orbit, necessarily subject to " great disturbing influences may sooner or later cross our atmosphere and be " intercepted by the body of the globe."

The lecture of Professor Snell is an able popular exposition of the subject of planetary disturbances.

METEOROLOGY.

Of the matter contained in the present volume, that of the greatest importance on account of its immediate connection with a great scientific movement now in progress in Canada, is the body of directions for the meteorological observations adopted by the Smithsonian Institution. These instructions are well worthy of the study of all persons interested in this class of research.

Following the directions to observers is an account of a series of observations carried on, chiefly for the purpose of ascertaining the duration of thunder claps.

The Report of Professor Müller on galvanism, extending as it does through upwards of 100 closely printed pages, puts any attempt at analysis in our limited space utterly out of the question; we can

only, therefore, refer our readers, for more ample details, to the pages of the work.

In laying down for the present the report of the Smithsonian Institution, (and it is with no little regret that we lay it down,) we derive our chief consolation from the recollection that it is not a solitary work, but one of a series, and that we may look forward to a renewal on each succeeding year of the enjoyment we have found in the perusal of the volume that we have just closed.

G. T. K.

SCIENTIFIC AND LITERARY NOTES.

GEOLOGY AND MINERALOGY.

FOSSILS FROM ANTICOSTI.

During a recent visit to the Museum of the Geological Survey in Montreal, we were much gratified by the inspection of a fine collection of fossils, just received by Sir William Logan, from the Island of Anticosti. The greatest praise is due to Mr. Richardson, by whom, in the short space of a few months, this really magnificent collection was obtained. A preliminary examination by Professor Hall, of Albany, and Mr. Billings, the palæontologist attached to the Survey, has shewn the existence of a great number of new Brachiopods and other types—some, indeed, of a character at present altogether problematical. Amongst other facts of interest brought to light by the collection, we may mention the simultaneous occurrence in one of the Anticosti beds, of many well-marked forms belonging to both the Lower and Upper divisions of the Silurian series: a phenomenon not hitherto observed, or at least to a similar extent, in American rocks—the line of demarcation between the Upper and Lower Silurians of the Western World, being, as a general rule, very strongly pronounced. The lowest of the observed beds in Anticosti itself, belongs to the Hudson River Group; but the Sillery formation (the next in an ascending order) so largely developed along the Southern shores of the St. Lawrence, appears to be entirely wanting. Geologists may look forward with much interest, to the results of Professor Hall's detailed examination of this important addition to our knowledge of Palæozoic forms.

ASAPHUS LATIMARGINATUS.

[*A. Canadensis*—E. J. C.]

In the *Canadian Journal* for September of last year (vol. 1, p. 482), we called attention, under the name of *Asaphus Canadensis*, to a new form of Trilobite, from Whitby, in Canada West. Quite recently, we have received a letter from Professor Hall, in which that able palæontologist suggests to us that the Trilobite in question is probably his *Asaphus latimarginatus*. Professor Hall states that the

Museum of the Geological Survey of Canada has lately received some very perfect specimens of that species from the neighbourhood of Whitby; and he kindly promises us a drawing and revised description of his original species, for an ensuing number of the Journal. The only figures of *Asaphus latimarginatus* that we have had an opportunity of examining, consist merely of two more or less imperfect caudal shields given in the first volume of Hall's Palæontology of New York. Neither thorax nor buckler has, we believe, been hitherto figured or described—at least beyond the brief description given in our note in the number of the *Canadian Journal* already alluded to. If the two forms prove to be identical, the original name of *A. latimarginatus*, as applied by Prof. Hall to the species founded on the two imperfect caudal shields figured by him in his Palæontology, must, of course, take the place of *A. Canadensis*, notwithstanding the appropriateness of the latter. Up to the present time, indeed, it is only in Canada that anything like complete specimens have been met with. The following is a description of the form to which our original remarks applied:

Cephalic shield pointed anteriorly, and in its general outline closely resembling that of *Asaphus platycephalus**, but with the posterior angles terminating in horns† which extend downwards to the bottom of the fourth thoracic segment. Facial sutures united in front at the extreme anterior margin of the buckler, and terminating as in *A. platycephalus* about midway between the glabella and the angles of the head-shield. Glabella very feebly raised; broad, and somewhat squared above; but without furrows of any kind. Eyes apparently as in *A. platycephalus*, but much destroyed in all the specimens examined. For dimensions, see below.

Thorax with eight segments. Pleuræ somewhat sabre-shaped (the curve upwards‡); grooved to about half their length from the axis outwards, and then crossed obliquely by a curvilinear ridge: the points of the pleuræ beyond the ridge, delicately striated.

Caudal shield with well developed axis: the axis tapering, and terminating rather abruptly before reaching the extremity of the pygidium; number of the rings not observable in the specimens examined.§ Pleuræ 14 in number, without grooves or ridges; bent downwards abruptly near the striated margin into which they merge. The lower ones, almost vertical.

Whole surface of the trilobite finely punctured, except at the striated limb. The punctures on the pleuræ, larger and farther apart than those on the axis. Also of a crescented or semi-circular form, with the convex and more deeply indented side turned inwards.

Relative (approximate) dimensions:—Assumed length of Buckler = 1. Glabella, length = ·812. Thorax, length = ·875. Pygidium, length = 1·06. Middle lobe of Thorax, breadth = ·50 to ·60. Outer lobes (each) breadth = ·70. The small breadth of the middle lobe in relation to the side lobes, as compared with *Asaphus platycephalus*, appears to be of some importance, unless it be a mere sexual

* *Isotelus gigas*, Auct.

† This part of the head-shield is very obscure in the specimens hitherto examined. We were led at first to believe that the angles were rounded.

‡ This, however, is only to be seen when the pleuræ have become accidentally separated to a certain extent from one another.

§ Since the above description was written, the son of His Excellency the Governor General, has kindly submitted to us some specimens obtained by him personally from the Whitby quarries. In one of these, the pygidium of a young individual, fourteen rings may be counted in the axis.

difference. Where, however, the pleuræ are bent, the length of the side lobes can rarely be estimated with any great exactness.

The average adult size of these trilobites appears to be about 4½ inches in length, by about 3 inches in breadth; but, judging from isolated fragments, larger individuals no doubt occur. Many of the Whitby specimens, at the same time, are much below the above dimensions. Most of them are converted into iron pyrites. The *Asaphus Barrandi* of Hall appears to be a closely related species.

FOSSILS FROM ALTERED ROCKS IN EASTERN MASSACHUSETTS.

A very interesting discovery of a trilobite—a species of Paradoxides—in the metamorphic rocks of Quincy and Baintree, about ten miles South of Boston, has just been announced to the scientific world, by Professor W. B. Rogers. The true place of these rocks, hitherto of uncertain paleozoic range, would thus appear to belong to quite the base of the Silurian series: at least if the trilobite in question be really a paradoxides—in which case, it will also be of interest, as constituting the first true species of that genus met with in American rocks since the announcement of Green's debatable *Paradoxides Harlani* in 1832. Full particulars of this discovery will be found in the last October number of the Edinburgh New Philosophical Journal; and in the Proceedings of the Natural History Society of Boston, for the same month.

BURR-STONE.

A curious deposit of Burr-stone, constituting a vein of considerable thickness, has lately been discovered by Sir William Logan, in the gneiss of Chatham, in Canada East. The stone, probably a siliceous deposit from heated waters, occurs, according to Sir William, in close association with several complicated veins of igneous rock of at least three different periods of formation. As the stone is of excellent quality, and readily obtainable, the discovery—apart from the scientific interest belonging to the mode of occurrence of the deposit—is one of no little importance. Specimens may be seen in the Museum of the Geological Survey at Montreal.

RED OXIDE OF COPPER.

Mr. James Gilbert, lately returned from California, has presented to the Institute, some specimens of red copper ore from the Arizona mines, 110 miles S. E. of Fort Yunia, and about 35 miles from the River Gila. As samples, the specimens are extremely rich, being almost free from rock matter. They contain small strings of native copper, from which the Cu^2O has evidently been derived; and by a further process of alteration, the ore is converted externally, into malachite, The occurrence of red copper in California has not hitherto been announced in any of our treatises on Mineralogy. We are ignorant of its geological associations.

VANADINITE.

In the last number of the *Journal*, (vol. 1, page 553), an analysis, by Rammelsberg, of Vanadinite from Windisch-Kappel, was given; the results of which lead to the inference that VO^3 and PO^5 are isomorphous. Adolf Kengott, (in Poggendorff's Annalen, 1856, No. 9), has subjected this analysis to a very elaborate discussion, in which he seeks to maintain that the loss of 3.21 per cent. therein exhibited, must be due to some cause other than accidental. To account for this loss, he assumes the original existence in the mineral of the hypothetical com-

pound VO^5. Rammelsberg's analysis gave 17.41 per cent. of VO^3 : a value corresponding to 20.31 per cent. of VO^5. In this manner the total results of the analysis are brought up to 99.69; and the isomorphism of Vanadinite with Pyromorphite satisfactorily explained. Before this view can be received, however, it will be for the chemist to determine if there be any real grounds for the assumption of the existence of this higher oxygen compound. So far as present researches go, the tendency of vanadic acid, VO^3, would appear to be altogether towards reduction. The question, however, here, is not the conversion of VO^3 into VO^5, but the reverse: a process which we might readily conceive to take place, were the existence of the latter compound allowed to be probable.

E. J. C.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Cheltenham, 6th August, 1856.

After the requisite preliminary business, conducted by the General Committee of the Association, and including the reading of the Report of the Council, and of that of the Kew Committee, the body of members assembled to witness the resignation of the Chair by the Duke of Argyle, to his successor, Professor Daubeny, and to hear the President's Address. On this occasion the occupation of the Chair of the British Association by one not only distinguished as a Chemist, but by one who is no less eminent as a Botanist, gave a new character to the Presidential Address. After some preliminary remarks of a personal nature, Dr. Daubeny proceeded with his address, from which we have only room for a brief selection of passages of special interest. Referring to the British Association as alike valuable as an efficient instrument for the furtherance of scientific objects, and as a model after which other associated scientific bodies have been organized, the President thus proceeded:

It is rather remarkable that the first idea of an Association of such a kind should have suggested itself only a year after death had deprived us of our three most distinguished philosophers:—for who had we then left to compare with Davy for the brilliancy and importance of his discoveries; with Young for the singular union of almost universal acquirements with admirable powers of invention; and with Wollaston for an acuteness of mental vision, which gave him the same advantage in the pursuits of science which the naturalist, armed with a microscope has over the unassisted observer? Just as in the animal economy the *vis medicatrix naturæ* sometimes makes an extraordinary effort to repair the damage inflicted by injury or disease, so it would seem as if Science, conscious of the loss she had sustained in the almost simultaneous extinction of her three brightest luminaries, endeavoured to make good the deficiency by concentrating into one *focus* those that yet remained, to light her onwards on her path. At any rate, the progress which the Natural Sciences have made since that period, although doubtless attributable to several concurrent causes, is a fact which must not be overlooked in estimating the services rendered by this Association to the cause of human advancement; nor can I in any better manner point out its value than by bringing before your notice a few of the additions to our knowledge which have been made since I last addressed you.

Beginning then with Chemistry, as the subject with which I am most familiar, let me remind you, that at a period not much more remote than the one alluded to, all of it that could be quoted as really worthy the name of a science was comprehended within the limits of the mineral kingdom. Here at least the outline had been traced out with sufficient precision—the general laws established on a firm basis—the nomenclature framed with logical exactness—the facts consistent with each other, and presented in a scientific and luminous form. Thus a philosopher, like Sir Humphrey Davy, who had contributed in so eminent a degree to bring the science into this satisfactory condition, might, at the close of his career, have despaired of adding anything worthy of his name to the domain of chemistry, and have sighed for other worlds to subdue. But there was a world almost as little known to the chemists of that period as was the Western Hemisphere to the Macedonian Conqueror,—a World comprising an infinite variety of important products, called into existence by the mysterious operation of the vital principle, and therefore placed, as was imagined, almost beyond the reach of experimental research. This is the new World of Chemistry, which the Continental philosophers in the first instance, and subsequently those of our own country, have during the last twenty years been busy in exploring, and by so doing have not only bridged over the Gulf which had before separated by an impassable barrier the kingdoms of inorganic and of organic nature, but also have added provinces as extensive and as fertile as those we were in possession of before, to the partrimony of Science.

It is indeed singular, that whilst the supposed elements of mineral bodies are very numerous, the combinations between them should be comparatively few; whereas amongst those of vegetable and animal origin, where the ultimate elements are so limited in point of number, the combinations which they form appear almost infinite. Carbon and hydrogen, for instance, constitute, as it were, the keystone of every organic fabric; whilst oxygen, nitrogen, and less frequently sulphur and phosphorus, serve almost alone to build up their superstructure. And yet what an infinity of products is brought about by ringing the changes upon this scanty alphabet! Even one series of bodies alone, that known by the name of the Fatty Acids, comprises several hundred well-ascertained combinations, founded however upon a single class of hydro-carbons or compound radicals, in which the carbon and hydrogen stand to each other in equal atomic proportions, and are in each case acidified by the same number of equivalents of oxygen. These acids are all monobasic, or combine with only one proportion of base; but add to any one of them two equivalents of carbonic acid, and you obtain a member of a second series, which is bibasic, or is capable of forming two classes of salts. The above therefore constitute a double series, as it were, of organic acids, the members of which are mutually related in the manner pointed out, and differ from each other in their mode of combining according to the relation between their respective elements. But already, by the labours of Hofmann and of other chemists, two other double series of acids, the one monobasic, the other bibasic, mutually related exactly in the same manner as those above, have been brought to light; each series no doubt characterized by an equally numerous appendage of alcohols, of æthers, and of aldehydes, to say nothing of the secondary compounds resulting from the union of each of these bodies with others.

Hence the more insight we obtain into the chemistry of organic substances the more we become bewildered with their complexity, and in investigating these phe-

nomena, find ourselves in the condition of the explorer of a new continent, who, although he might see the same sun over his head, the same ocean rolling at his feet, the same geological structure in the rocks that were piled around him, and was thus assured that he still continued a denizen of his own planet, and subject to those physical laws to which he had been before amenable, yet at every step he took was met by some novel object, and startled with some strange and portentous production of Nature's fecundity. Even so the chemist of the present day, whilst he recognizes in the world of organic life the same general laws which prevail throughout the mineral kingdom, is nevertheless astonished and perplexed by the multiplicity of new bodies that present themselves, the wondrous changes in them resulting from slight differences in molecular arrangement, and the simple nature of the machinery by which such complicated effects are brought about. And as the New World might never have been discovered, or, at all events, would not have been brought under our subjection, without those improvements in naval architecture which had taken place prior to the age of Columbus, so the secrets of organic chemistry would have long remained unelicited, but for the facilities in the methods of analysis which were introduced by Liebig. Before his time the determination of the component elements of an organic substance was a task of so much skill as well as labour, that only the most accomplished analysts—such men, for instance, as my lamented friend Dr. Prout in this country, or as the great Berzelius in Sweden—could be depended upon for such a work; and hence the data upon which we could rely for deducing any general conclusions went on accumulating with extreme slowness. But the new methods of analysis invented by Liebig have so simplified and so faciliated the processes, that a student, after a few months' practical instruction in a laboratory, can, in many instances, arrive at results sufficiently precise to be made the basis of calculation, and thus to enable the master mind, which is capable of availing itself of the facts before it, to breathe life into these dry numerical details,—just as the sculptor, by a few finishing stokes, brings out the expression of the statue, which has been prepared for him by the laborious chiselling of a number of subordinate workmen. And as the established laws and institutions of the Old World have been modified—may I not say in some instances rectified?—by the insensible influence of those of the New, so have the principles that had been deduced from the phenomena of the mineral kingdom undergone in many instances a correction from the new discoveries made in the chemistry of the animal and vegetable creation. It was a great step indeed in the progress of the science, when Lavoisier set the example of an appeal to the balance in all our experimental researches, and the Atomic Theory of Dalton may be regarded as the necessary, although somewhat tardy, result of the greater numerical precision thus introduced. But no less important was the advance achieved, when structure and polarity were recognized as influencing the condition of matter; and when the nature of a body was felt to be determined, not only by the condition of its component elements, but also by their mutual arrangement and collocation—a principle which, first illustrated amongst the products of organic life, has since been found to extend alike to all chemical substances whatever.

Formerly it had been the rule to set down the bodies which form the constituents of the substances we analyzed, and which had never yet under our hands undergone decomposition, as elementary; but the discovery of cyanogen in the first instance, and the recognition of several other compound radicals in organic chemistry more lately, naturally suggest the idea that many of the so-called elements of

inorganic matter may likewise be compounds, differing from the organic radicals above mentioned merely in their constituents being bound together by a closer affinity. And this conjecture is confirmed by the curious numerical relations subsisting between the atomic weights of several of these supposed elements; as, for example, between chlorine, bromine and iodine : an extension of the grand generalization of Dalton, which, although it was unforeseen by the Founder of the system, and therefore, like Gay-Lussac's Theory of Volume, might very possibly have been repudiated by him, had it been proposed for his acceptance, will be regarded by others as establishing, in a manner more conclusive than before, the soundness of his antecedent deductions. What, indeed, can be a greater triumph for the theorist, than to find that a law of nature which he has had the glory of establishing by a long and painful process of induction, not only accommodates itself to all the new facts which the progress of discovery has since brought to light, but is itself the consequence of a still more general and comprehensive principle, which philosophers, even at this distance of time, are still engaged in unfolding?

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But passing over speculations which have not as yet received the general assent of chemists, let me advert to others of an older date, possessing as I conceive, the strongest internal evidence in their favour, which the case admits, from the harmony they tend to introduce into the chaos of facts which the late discoveries in organic chemistry have brought to light. Amongst these, one of the most generally received, and at the same time one of the most universal application, is that which represents the several combinations resulting from organic forces, as being put together according to a particular model or type, which impresses upon the aggregate formed certain common properties, and also causes it to undergo change most readily, through the substitution of some other element in the place of one of those which already enters into its constitution. And this principle, having been established with regard to one class of bodies, has since been extended to the rest; for it now begins to be maintained, that in every case of chemical decomposition a new element is introduced in the place of one of those which constituted a part of the original compound, so that the addition of a fresh ingredient is necessarily accompanied by the elimination of an old one. The same doctrine, too, has even been extended to the case of combination with a body regarded as elementary, for here also the particles are considered as being in a state of binary combination one with the other, owing perhaps to their existing in opposite electrical conditions, and therefore possessing for each other a certain degree of chemical affinity. Thus, when we unite hydrogen with oxygen, we substitute an atom of the latter for one of the former, previously combined with the same element.

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To the microscope we owe all that is as yet known with respect to the reproductive process in cryptogamous plants, which are now shown to possess a structure analogous to that of flowering ones in respect to their organs of reproduction; not, indeed, as Hedwig supposed, that parts corresponding to stamens and pistils in appearance and structure can be discovered in them, but that as the primary distinction of sexes seems to run throughout the Vegetable Kingdom, new parts are superadded to a structure common to all as we ascend in the scale of creation, until from the simple cell, which, in consequence of some differences of structure, to our eyes inappreciable, appears to exercise in one case the function of the male, in another of the female, as is found the case in certain of the Confervæ, we arrive

at length at the complicated machinery exhibited in flowering plants, in which the cell containing the fecundating principle is first matured in the stamen, and afterwards transmitted, through an elaborate apparatus, to the cells of the ovule, which is in like manner enveloped in its matrix, and protected by the series of investing membranes which constitutes the seed-vessel. Thus, as Goethe long ago observed, and as modern physiologists have since shown to be the case, the more imperfect a being is, the more its individual parts resemble each other—the progress of development, both in the Animal and Vegetable Kingdoms, always proceeding from the like to the unlike, from the general to the particular. But whilst the researches of Brown and others have shown that there is no abrupt line of division in the Vegetable Kingdom, and that one common structure pervades the whole, the later inquiries of Suminski, Hofmeister, Unger, Griffith, and Henfrey, have pointed out several curious and unlooked-for analogies between plants and animals. I may mention, in the first place, as an instance of this analogy between plants and animals, the existence of moving molecules, or phytosperms, in the antheridia of ferns and other Cryptogams, borne out, as it has been in so remarkable a manner, by the almost simultaneous observations of Bischoff and Meissner on the egg, confirmatory of those formerly announced by Barry and Newport, and by the researches of Suminski, Thuret, and Pringsheim, with respect to the ovule of plants. I may refer you also to a paper read at the last Meeting of the Association, by Dr. Cohn, of Breslau, who, in bringing this subject before the Natural History Section, adduced instances of a distinction of sexes which had come under his observation in the lower Algæ. In like manner a curious correspondence has been traced between the lower tribes of animals and plants, in the circumstance of both being subject to the law of what is called alternate generation. This consists in a sort of cycle of changes from one kind of being to another, which was first detected in some of the lower tribes of animals; a pair of insects, for example, producing a progeny differing from themselves in outward appearance and internal structure, and these reproducing their kind without any renewed sexual union,—the progeny in these cases consisting of females only. At length, after a succession of such generations, the offspring reverts to its primæval type, and pairs of male and female insects, of the original form, are reproduced, which complete the cycle, by giving rise in their turn to a breed presenting the same characters as those which belong to their own progenitors. An ingenious comparison had been instituted by Owen and others between this alternation of generations in the animal, and the alternate production of leaves and blossoms in the plant; but the researches to which I especially allude have rendered this no longer a matter of mere speculation or inference, inasmuch as they have shown the same thing to occur in ferns, in lycopodia, in mosses, nay, even in the confervæ. We are indebted to Prof. Henfrey for a valuable contribution to our Transactions in 1851 on these subjects, given in the form of a Report on the Higher Cryptogamous Plants; from which it at least appears that the proofs of sexuality in the Cryptogamia rank in the same scale, as to completeness, as those regarding flowering plants did before the access of the pollen tubes to the ovule had been demonstrated. Indeed, if the observations of Pringsheim with respect to certain of the Algæ are to be relied upon, the analogy between the productive process in plants and animals is even more clearly made out in these lower tribes than it is in those of higher organization. It also appears that the production in ferns and other Acrogens of what has been callled a *pro-embryo;* the evolution of antheridia and archegonia, or of male and female organs, from the former; and the generation from the archegonia

of a frond bearing spores upon its under surface, is analogous to what takes place in flowering plants in general; where the seed, when it germinates, produces stem, roots, and leaves; the stem for many generations gives rise to nothing but shoots like itself; until at length a flower springs from it, which contains within itself for the most part the organs of both sexes united, and, therefore, occasions the reproduction of the same seed with which the chain of phenomena commenced. This is the principle which a learned Professor at Berlin has rather obscurely shadowed out in his treatise on the Rejuvenescence of Plants, and which may perhaps be regarded as one, at least, of the means by which Nature provides for the stability of the forms of organic life she has created, by imparting to each plant a tendency to revert to the primeval type.

To the elder De Candolle we are also indebted for some of our most philosophical views with respect to the laws which regulate the distribution of plants over the globe,—views which have been developed and extended, but by no means subverted, by the investigations of subsequent writers; amongst whom Sir Charles Lyell, in his 'Principles of Geology,' and the younger De Candolle, a worthy inheritor of his father's reputation, in his recently published work on Botanical Geography, have espescially signalized themselves. But it is to the late Prof. Edward Forbes, and to Dr. Joseph Hooker, that we have principally to attribute the removal of those anomalies, which threw a certain degree of doubt upon the principles laid down by De Candolle in 1820, in his celebrated article on the Geography of Plants, contained in the 'Dictionnaire des Sciences Naturelles,' where the derivaion of each species from an individual, or a pair of individuals, created in one particular locality, was made the starting point of all our inquiries. These anomalies were of two different kinds, and pointed in two opposite directions: for we had in some cases to explain the occurrence of a peculiar Flora in islands cut off from the rest of the world, except through the medium of a wide intervening ocean; and in other cases to reconcile the fact of the same or of allied species being diffused over vast areas, the several portions of which are at the present time separated from each other in such a manner, as to prevent the possibility of the migration of plants from one to the other. Indeed, after making due allowances for those curious contrivances by which Nature has in many instances provided for the transmission of species over different parts of the same continent, and even across the ocean, and which are so well pointed out in De Candolle's original essay, we are compelled to admit the apparent inefficiency of existing causes to account for the distribution of the larger number of species; and must confess that the explanation fails us often where it is most needed, for the Compositæ in spite of those feathery appendages they possess, which are so favorable to the wide dissemination of their seeds, might be inferred, by their general absence from the fossil Flora, to have diffused themselves in a less degree than many other families have done. And on the other hand, it is found, that under existing circumstances, those Compositæ, which are disseminated throughout the area of the Great Pacific, belong in many cases to species destitute of these auxiliaries to transmission. But here Geology comes to our aid; for by pointing out the probability of the submergence of continents on the one hand, and the elevation of tracts of land on the other, it enables us to explain the occurrence of the same plants in some islands or continents now wholly unconnected, and the existence of a distinct Flora in others too isolated to obtain it under present circumstances from without. In the one case we may suppose the plants to have been distributed over the whole area before its several parts became

disunited by the catastrophes which supervened; in the other, we may regard the peculiar Flora now existing as merely the wreck, as it were, of one which once overspread a large tract of land, of which all but the little patch on which it is now found had been since submerged. Upon this subject our opinions may in some measure be swayed by the nature of the conclusion we arrive at with respect to the length of time during which seeds are capable of mantaining their vitality; for if after remaining for an indefinite period in the earth they were capable of germinating, it would doubtless be easier to understand the revival, under favorable circumstances, of plants which had existed before the severance of a tract of land from the continent in which they are indigenous. An inquiry has accordingly been carried on for the last fifteen years under the auspices of, and with the aid of funds supplied by, this Association, the results of which, it is but fair to say, by no means corroborate the reports that had been from time to time given us with respect to the extreme longevity of certain plants, exemplified, as it was said, in the case of the mummy-wheat and other somewhat dubious instances; inasmuch as they tend to show, that none of the seeds which were tested, although they were placed under the most favorable artificial conditions that could be devised, vegetated after a period of forty-nine years; that only twenty out of 288 species did so after twenty years; whilst by far the larger number had lost their germinating power in the course of ten. These results, indeed, being merely negative, ought not to outweigh such positive statements on the contrary side as come before us recommended by respectable authority, such, for instance, as that respecting a Nelumbium seed, which germinated after having been preserved in Sir Hans Sloane's Herbarium for 150 years; still, however, they throw suspicion as to the existence in seeds of that capacity of preserving their vitality almost indefinitely, which alone would warrant us in calling to our aid this principle in explaining the wide geographical range which certain species of plants affect.

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Amongst the many services rendered to the Natural Sciences by Dr. Hooker, in conjunction with his fellow traveller, Dr. Thomson, one of the greatest I conceive to be, that they have not only protested against that undue multiplication of species, which had taken place by exalting minute points of difference into grounds of radical and primary distinction, but that they have also practically illustrated their views with respect to the natural families which have been described by them in the volume alluded to. They have thus contributed materially to remove another difficulty which stood in the way of the adoption of the theory of specific centres, —I mean the replacement of forms of vegetation in adjoining countries by others, not identical, but only as it should seem allied; for it follows from the principles laid down by these authors, that such apparently distinct species may after all have been only varieties, produced by the operation of external causes acting upon the same species during long periods of time.

But if this be allowed, what limits, it may be asked, are we to assign to the changes which a plant is capable of undergoing,—and in what way can we oppose the principle of the transmutation of species, which has of late excited so much attention, and the admission of which is considered to involve such startling consequences? I must refer you to the writings of modern physiologists for a full discussion of this question. All that I shall venture to remark is, that had not Nature herself assigned certain boundaries to the changes which plants are capable of undergoing, there would seem no reason why any species at all should be restricted

within a definite area, since the unlimited adaptation to external conditions which it would then possess might enable it to diffuse itself throughout the world, as easily as it has done over that portion of space within which it is actually circumscribed. Dr. Hooker instances certain species of Coprosma, of Celmisia, and a kind of Australian Fern, the *Lomaria procera*, which have undergone such striking changes in their passage from one portion of the Great Pacific to another, that they are scarcely recognizable as the same, and have actually been regarded by preceding botanists as distinct species. But he does not state that any of these plants have ever been seen beyond the above-mentioned precincts; and yet if Nature had not imposed some limits to the susceptibility of change, one does not see why they might not have spread over a much larger portion of the earth, in a form more or less modified by external circumstances. The younger De Candolle, in his late admirable treatise already referred to, has enumerated about 117 species of plants which have been thus diffused over at least a third of the surface of the globe, but these apparently owed their power of transmigration to their insusceptibility of change, for it does not appear that they have been much modified by the effect of climate or locality, notwithstanding the extreme difference in the external conditions to which they were subjected. On the other hand, it seems to be a general law, that plants whose organization is more easily affected by external agencies become from that very cause, more circumscribed in their range of distribution; simply because a greater difference in the circumstances under which they would be placed brought with it an amount of change in their structure which exceded the limits prescribed to it by Nature. In short, without pretending to do more than to divine the character of those impediments, which appear ever to prevent the changes of which a plant is suceptible from proceeding beyond a certain limit, we seem to catch a glimpse of a general law of Nature, not limited to one of her kingdoms, but extending everywhere throughout her jurisdiction,—a law, the aim of which may be inferred to be that of maintaining the existing order of the universe, without any material or permanent alteration, throughout all time, until the fiat of Omnipotence has gone forth for its destruction. The will which confines the variations in the vegtable structure within a certain range, lest the order of creation should be disturbed by the introduction of an indefinite number of intermediate forms is apparently the same in its motive as that which brings back the celestial luminaries to their original orbits, after the completion of a cycle of changes induced by their mutual perturbations; it is the same which says to the ocean, Thus far shalt thou go, and no further; and to the winds, Your violence, however apparently capricious and abnormal, shall nevertheless be constrained within certain prescribed limits—

> Ni faciat, maria et terras cœlumque profundum,
> Quippe ferant rapidi secum, verrantque per auras.

The whole, indeed, resolves itself into, or at least is intimately connected with, that law of symmetry to which Nature seems ever striving to conform, and which possesses the same significance in the organic world, which the law of definite proportions does in the inorganic. It is the principle which the prophetic genius of Goethe had divined, long before it had been proved by the labours of physiologists to be a reality, and to which the poet attached such importance, that the celebrated discussion as to its merits which took place in 1830 between Cuvier and Geoffry St. Hilaire so engrossed his mind, as to deprive him, as his biographer informs us, of all interest in one of the most portentous political events of modern days which was enacting at the very same epoch,—I mean the subversion of the Bourbon dynasty.

It is, indeed, not less calculated to subserve to the gratification of our sense of the Beautiful than to provide against too wide a departure from that order of creation which its great Author has from the beginning instituted; and, as two learned Professors of a sister kingdom have pointed out in Memoirs laid before this Association, and have since embodied in a distinct treatise, manifests itself not less in the geometrical adjustment of the branches of a plant, and of the scales of a fir-apple —nay even, as they have wished to prove, in the correspondence between the form of the fruit and that of the tree on which it grows—than in the frequent juxtaposition of the complimentary rays of the spectrum, by which that harmony of colour is produced in Nature which we are always striving, however unsuccessfully, to imitate in Art. The law, indeed, seems to be nothing else than a direct consequence of that unity of design pervading the universe, which so bespeaks a common Creator—of the existence in the mind of the Deity of a sort of archetype, to which His various works have all, to a certain extent, been accommodated; so that the earlier forms of life may be regarded as types of those of latter creation, and the more complex ones but as developments of rudimentary parts existing in the more simple.

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I might be disposed to claim for the recent investigations of botanists some share in fixing the relative antiquity of particular portions of the globe, for from the Floras they have given us of different islands in the Great Pacific, it would appear that the families of plants which characterize some groups are of a more complicated organization than those of another. Thus, whilst Otaheite chiefly contains Orchids, Apocyneæ, Asclepiadeæ, and Urticeæ; the Sandwich Islands possess Lobeliaceæ and Goodenoviæ; and the Galapagos Islands, New Zealand and Juan Fernandez, Compositæ, the highest form, perhaps, of dicotyledonous plants. In deducing this consequence, however, I am proceeding upon a principle which has lately met with opposition, although it was formerly regarded as one of the axioms in Geology. Amongst these, indeed, there was none which a few years ago seemed so little likely to be disputed as that the classes of animals and vegetables which possessed the most complicated structure were preceded by others of a more simple one; and that when we traced back the succession of beings to the lowest and the earliest of the sedimentary formations, we arrived at length at a class of rocks, the deposition of which must be inferred, from the almost entire absence of organic remains, to have followed very soon after the first dawn of creation. But the recognition of the footsteps and remains of reptiles in beds of an earlier date than was before assigned to them, tended to corroborate the inferences which had been previously deduced from the discovery, in a few rare instances, in rocks of the secondary age, of mammalian remains; and thus has induced certain eminent geologists boldly to dispute, whether from the earliest to the latest period of the earth's history any gradation of beings can in reality be detected. Into this controversy I shall only enter at present, so far as to point out an easy method of determining the fact, that organic remains never can have existed in a particular rock, even although it may have been subjected to such metamorphic action as would have obliterated all traces of their presence. This is simply to ascertain that the material in question is utterly destitute of phosphoric acid; for inasmuch as every form of life appears to be essentially associated with this principle, and as no amount of heat would be sufficient to dissipate it when in a state of combination, whatever quantity of phosphoric acid had in this manner been introduced into the rock, must

have continued there till the end of time, notwithstanding any igneous operations which the materials might have afterwards undergone. But as the discovery of very minute traces of phosphoric acid, when mixed with the other ingredients of a rock, is a problem of no small difficulty, an indirect method of ascertaining its presence suggested itself to me in some experiments of the kind which I have instituted, namely, that of sowing some kind of seed, such for instance as barley, in a sample of the pulverized rock, and determining whether the crop obtained yielded more phosphoric acid than was present in the grain, it being evident that any excess must have been derived from the rock from which it drew its nourishment. Should it appear by an extensive induction of particulars, that none of the rocks lying at the base of the Silurian formation, which have come before us, contain more phosphoric acid than the minute quantity I detected in the slates of Bangor and Llanberris, which were tested in the above manner, it might perhaps be warrantable hereafter to infer that we had really touched upon those formations, that had been deposited at a time when organic beings were only just beginning to start into existence, and to which therefore, the term Azoic, assigned to these rocks by some of the most eminent of our geologists, might not be inappropriate. The proofs of the former extension of glaciers in the Northern hemisphere, far beyond their actual limits, tend also to complicate the question which has at all times so much engaged the attention of cosmogonists with respect to the ancient temperature of the earth's surface, compelling us to admit that, at least during the latter of its epochs, oscillations of heat and cold must have occurred, to interfere with the progress of refrigeration which was taking place in the crust. On the other hand, facts of an opposite tendency, such as the discovery announced at our last meeting by Capt. Belcher, of the skeleton of an Ichthyosaurus in lat. 77°, and of the trunk of a tree standing in an erect position in lat. 75°, have been multiplying upon us within the same period; inasmuch as they appear to imply, that a much higher temperature in former times pervaded the Arctic regions that can be referred to local causes, and therefore force upon us the admission, that the internal heat of the nucleus of our globe must at one time have influenced in a more marked manner than at present the temperature of its crust.

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Twenty years ago it was thought necessary to explain at our meetings the character and objects of this Association, and to vindicate it from the denunciations fulminated against it by individuals, and even by parties of men, who held it up as dangerous to religion, and subversive of sound principles in theology. Now so marked is the change in public feeling, that we are solicited by the clergy, no less than by the laity, to hold our meetings within their precincts; and we have never received a heartier welcome than in the city in which we are now assembled, which values itself so especially, and with such good reason, on the extent and excellence of its educational establishments. It begins, indeed, to be generally felt, that amongst the faculties of the mind, upon the development of which in youth success in after life mainly depends, there are some which are best improved through the cultivation of the Physical Sciences, and that the rudiments of those sciences are most easily acquired at an early period of life. That power of minute observation —those habits of method and arrangement—that aptitude for patient and laborious inquiry—that tact and sagacity in deducing inferences from evidence short of demonstration, which the Natural Sciences more particularly promote, are the fruits of early education, and acquired with difficulty at a later period. It is during child-

hood, also, that the memory is most fresh and retentive and that the nomenclature of the sciences, which, from its crabbedness and technicality, often repels us at a more advanced age, is acquired almost without an effort. Although, therefore it can hardly be expected that the great schools in the country will assign to the Natural Sciences any important place in their systems of instruction until the Universities for which they are the seminaries set them the example, yet I cannot doubt but that, the signal once given, both masters and scholars will eagerly embrace a change so congenial to the tastes of youth, and so favorable to the development of their intellectual faculties. And has not, it may be asked, the signal been given by the admission of the Physical Sciences into the curriculum of our academical education? I trust that this question may be answered in the affirmative, if we are entitled to assume that the recognition of them which has already taken place will be constantly followed up by according to them some such substantial encouragement as that which has been afforded hitherto almost exclusively to classical literature. Our ability to accomplish this, with the means and appliances at our command, does not, I think, admit of dispute. All, therefore, that seems wanted, is, on the one hand, a more equal distribution of the existing emoluments between the several professions, and on the other, the admission of the claims of the sciences received into our educational system to share in the emoluments which up to this time, have been monopolized by the Classics. And, as it is far from my wish to curtail the older studies of the University of their proper share of support—for who that has passed through a course of academical study can be insensible of the advantages he has derived from that early discipline of the mind which flows from their cultivation?—I rejoice to think, that when the Legislature shall have completed the removal of those restrictions which have hitherto prevented us in many instances from consulting the claims of merit in the distribution of our emoluments, there will be ample means afforded for giving all needful encouragement to the newly-recognized studies, without trenching unduly upon that amount of pecuniary aid which has been hitherto accorded to the classics. In anticipation of which change, I look forward with confidence to the day when the requirements at Oxford in the department of Physical Sciences will become so general and so pressing, that no institution which professes to prepare the youth it instructs for academical competition will venture to risk its reputation by declining to admit these branches of study into its educational courses.

ON THE THEORY OF COMPOUND COLOURS WITH REFERENCE TO MIXTURES OF BLUE AND YELLOW LIGHT. BY MR. J. C. MAXWELL.

When we mix together blue and yellow paint, we obtain green paint. This fact is well known to all who have ever handled colours; and it is universally admitted that blue and yellow make green. Red, yellow, and blue being the primary colours among painters, green is regarded as a secondary colour, arising from the mixture of blue and yellow. Newton, however, found that the green of the spectrum was not the same thing as the mixture of two colours of the spectrum, for such a mixture could be separated by the prism, while the green of the spectrum resisted further decomposition. But still it was believed that yellow and blue would make a green, though not that of the spectrum. As far as I am aware, the first experiment on the subject is that of M. Plateau, who, before 1819, made a disc with alternate sectors of Prussian blue and gamboge, and observed that, when spinning, the resultant tint was not green, but a neutral grey, inclining

sometimes to yellow or blue, but never to green. Prof. J. D. Forbes, of Edinburgh, made similar experiments in 1849, with the same result. Prof. Helmholtz, of Königsberg, to whom we owe the most complete investigation on visible colour, has given the true explanation of this phenomenon. The result of mixing two coloured powders is not by any means the same as mixing the beams of light which flow from each separately. In the latter case we receive all the light which comes either from the one powder or the other. In the former, much of the light coming from one powder falls on a particle of the other, and we receive only that portion which has escaped absorption by one or other. Thus, the light coming from a mixture of blue and yellow powder, consists partly of light coming directly from blue particles or yellow particles, and partly of light acted on by both blue and yellow particles. This latter light is green, since the blue stops the red, yellow, and orange, and the yellow stops the blue and violet. I have made experiments on the mixture of blue and yellow *light*—by rapid rotation, by combined reflection and transmission, by viewing them out of a focus, in stripes, at a great distance, by throwing the colours of the spectrum on a screen, and by receiving them into the eye directly; and I have arranged a portable apparatus by which any one may see the result of this or any other mixture of the colours of the spectrum. In all these cases blue and yellow do *not* make green. I have also made experiments on the mixture of coloured powders. Those which I used principally were "mineral blue" (from copper) "and chrome yellow." Other blue and yellow pigments gave curious results, but it was more difficult to make the mixtures, and the greens were less uniform in tint. The mixtures of these colours were made by weight, and were painted on discs of paper, which were afterwards treated in the manner described in my paper 'On Colour as perceived by the Eye, in the *Transactions of the Royal Society of Edinburgh,* Vol. XXI., Part 2. The visible effect of the colour is estimated in terms of the standard-coloured papers: —vermilion (V,) ultramarine (U,) and emerald green (E.) The accuracy of the results, and their significance, can be best understood by referring to the paper before mentioned. I shall denote mineral blue by B, and chrome yellow by Y; and B_3 Y_5 means a mixture of three parts blue and five parts yellow.

Given Colour.				Standard Colours. V.	U.	E.	Co-efficient.
	B_8	100	=	2	36	7	45
B_7	Y_1	100	=	1	18	17	37
B_6	Y_2	100	=	4	11	34	49
B_5	Y_3	100	=	9	5	40	54
B_4	Y_4	100	=	15	1	40	56
B_3	Y_5	100	=	22	−2	44	64
B_2	Y_6	100	=	35	−10	51	76
B_1	Y_7	100	=	64	−19	64	109
	Y_8	100	=	180	−27	124	277

—The columns V., U., E. give the proportions of the stardard colours which are equivalent to 100 of the given colour; and the sum of V., U., E. gives a co-efficient, which gives a general idea of the brightness. It will be seen that the first admixture of yellow *diminishes* the brightness of the blue. The negative values of U. indicate that a mixture of V., U., and E. cannot be made equivalent to the given colour. The experiments from which these results were taken had the negative

values transferred to the other side of the equation. They were all made by means of the colour-top, and were verified by repetition at different times.

"ON SOME DICHROMATIC PHENOMENA AMONG SOLUTIONS, AND THE MEANS OF REPRESENTING THEM," BY DR. GLADSTONE.

This paper was an extension of Sir John Herschel's observations on dichromatism, that property whereby certain bodies appear of a different colour according to the quantity seen through. It depends generally on the less rapid absorption of the red ray as it penetrates a substance. A dichromatic solution was examined by placing it in a wedge-shaped glass-trough, held in such a position that a slit in a window-shutter was seen traversing the varying thicknesses of the liquid. The diversely coloured line of light thus produced was analyzed by a prism; and the resulting spectrum was represented in a diagram by means of coloured chalks on black paper, the true position of the apparent colours being determined by the fixed lines of the spectrum. In this way the citrate and comenamate of iron, sulphate of indigo, litmus in various conditions, cochineal, and chromium, and cobalt salts where examined and represented. Among the more notable results were the following:—A base, such as chromic oxide, produces very nearly the same spectral image with whatever acid it may be combined, although the salts may appear very different in colour to the unaided eye. Citrate of iron appears green, brown, or red, according to the quantity seen through. It transmits the red ray most easily, then the orange, then the green, which covers the space usually occupied by the yellow; it cuts off entirely the more refrangible half of the spectrum. Neutral litmus appears blue or red, according to the strength or depth of the solution. Alkalies cause a great development of the blue ray; acids cause a like increase of the orange, while the minimum of luminosity is altered to a position much nearer the blue. Boracic acid causes a development of the violet. Alkaline litmus was exhibited so strong that it appeared red, and slightly acid litmus so dilute that it looked bluish purple; indeed, on account of the easy transmissibility of the orange ray through an acid solution, the apparent paradox was maintained that a large amount of alkaline litmus is of a purer red than acid litmus itself. Another kind of dichromatism was examined, dependent not on the actual quantity of coloured material, but on the relative proportion of the solvent. Diagrams of the changing appearances of sulphocyanide of iron, of chloride of copper, and of chloride of cobalt were exhibited.

"ON A METHOD OF DRAWING THE THEORETICAL FORMS OF FARADAY'S LINES OF FORCE WITHOUT CALCULATION," BY MR. J. C. MAXWELL.

The method applies more particularly to those cases in which the lines are entirely parallel to one plane, such as the lines of electric currents in a thin plate, or those round a system of parallel electric currents. In such cases, if we know the forms of the lines of force in any two cases, we may combine them by simple addition of the functions on which the equations of the lines depend. Thus the system of lines in a uniform magnetic field is a series of parallel straight lines at equal intervals, and that for an infinite straight electric current perpendicular to the paper is a series of concentric circles whose radii are in geometric progression. Having drawn then two sets of lines on two separate sheets of paper and laid a third piece above, draw a third set of lines through the intersections of the first and second sets. This will be the system of lines in a uniform field disturbed by an electric current. The most interesting cases are those of uniform fields dis-

turbed by a small magnet. If we draw a circle of any diameter with the magnet for centre, and join those points in which the circle cuts the lines of force, the straight lines so drawn will be parallel and equi-distant, and it is easily shewn that they represent the actual lines of force in a paramagnetic, diamagnetic, or crystallized body, according to the nature of the original lines, the size of the circle, &c.

ON THE FORM OF LIGHTNING.

Mr. J. Nasmyth read a paper to the effect that the form of lightning as exhibited by nature was an irregular curved line, shooting from the earth below to the cloud above, and often continued from the cloud downwards again to some distant point of the earth; and this appearance was the result of the rapidly-shooting point of light, which constituted the true lightning, leaving on the eye the impression of the path it traced. These views led to much discussion in the Section.

(To be continued.)

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The Tenth Meeting of the American Association for the Advancement of Science was opened at Albany, in the Capitol of the State of New York, on the 20th of August, by Professor James B. Hall. A deputation from Montreal was introduced to the association on the following day, and Principal Dawson of McGill College, in the name of the deputation, communicated the invitation to the Association,—which at a subsequent meeting was accepted,—that the next meeting should be held in Montreal.

The American Association is still on a much smaller scale than its British prototype; and in some respects presents characteristic differences. The arrangements of business, which are left in the British Association exclusively in the hands of the Central Committee, were at Albany repeatedly made the subject of discussion by the whole body; and a good deal of time was lost in debates in general meeting, upon questions of order and constitutional forms, little calculated to interest those who had been attracted from a distance by the desire to listen to the communications of the distinguished representatives of American Science assembled on the occasion. Another characteristic, which could scarcely fail to strike those who are familiar with the proceedings of the British Association, was the absence of that numerous body of youthful aspirants for a place among the ranks of the Scientific Legion, which constitutes so valuable a feature in the Sections at Home. Already, chairs in the Colleges of England, Scotland, and Ireland, are filled by those who owed their first introduction to the Scientific world to the Sections of the British Association; and not the least of the benefits traceable to that institution pertain to this important feature of its organization, which has been so employed as to invite the younger students of Science into the arena, and stimulate them to compete with those whose rank has long been established by universal consent. The American Association on the contrary seems chiefly composed of the veterans of Science; nor was there wanting some appearance of an apprehension of any greater infusion of the popular element, such as the influence of the political institutions of that Country on all large and some-

what miscellaneous assemblies may perhaps fully justify. But whatever may be the effects of this absence of the predominating element of youthful aspirants for honors in the field of Scientific adventure, the assembly of so many of the most distinguished representatives of American Scientific Veterans, was a peculiarly acceptable feature to those who were allured from other countries, by the echo of their fame. Nor must it be overlooked that in whatever other respects the popular element may work, it is scarcely possible for a warmer or more hospitable welcome to be offered any where, than that which the citizens of Albany, and the Official representatives of the State of New York, tendered to the assembled Congress of American Science, and to the visitors attracted by the justly earned reputation of its members.

The great feature of interest at this meeting was the inauguration of the Dudley Astronomical Observatory. This observatory has been founded by the liberality of some citizens of Albany, among whom Mrs. Dudley, whose name it bears, has not only contributed upwards of $25,000 for the building and instruments but has announced a further donation of $50,000 towards its permanent endowment. The Hon. Edward Everett delivered a splendid oration on the occasion, in the presence of the Association, the dignitaries of the State, and the citizens of Albany, the venerable foundress herself occupying the seat of honour. The observatory is built in a solid and massive style, and finely situated on the brow of a hill; its erection was superintended by a committee of eminent astronomers, and the construction of the instruments was entrusted to Dr. Gould, who has accepted the appointment of Director. At a meeting in Section, Dr. Gould described in detail the new instruments. The minor instruments have been received, and the Observatory has been fitted up with these and others lent by Prof. Bache from the Coast Survey, but the reception of the larger instruments will be delayed for a few weeks longer. The Transit circle, combining in one the Transit telescope and meridian circle, was ordered from Pistor and Martius, the celebrated manufacturers of Berlin, by whom the new instrument at Ann Arbor was made. A number of improvements have been introduced in the Albany instruments, not perhaps all absolutely new, but an eclectic combination of late adaptations with new improvements. Dr. Gould made a distinction of modern astronomical instruments into two classes, the English and the German. The English is the massive type; the German, light and airy. The English instrument is the instrument of the engineer; the German, the instrument of the artist. In ordering the instruments for the Albany Observatory, the Doctor had endeavoured to combine the two, with, however, a preference to the German type. The circle is three feet in diameter, graduated to intervals of two minutes, and read by micrometers to tenths of seconds. The microscopes are four in number, and are not carried by moveable frames, but are imbedded in the piers. The piers themselves completely surround the circle so as to eliminate the effect of changes of temperature by radiation. The tube of the telescope is eight feet in length, and the object glass is eight inches clear aperture. The glass was made by Chance, of Birmingham, and ground by Pistor himself. The eye-piece, in addition to the diaphragm, is furnished with two micrometers, one for vertical, the other for horizontal motion, the use of these being for the circumpolar stars, whose motion is too slow for registration by the Chronographic method. One principle has been adhered to in the whole of the instrumental arrangements, namely: that every error is capable of being determined in two independent ways.

Much trouble was experienced in securing a good casting for the steel axis of the instrument. Three were found imperfect under the lathe, and the fourth was chosen, but even then, the pivots were made in separate pieces, which were set in very deeply, and welded.

Dr. Gould said he would have preferred a smaller instrument, in which the facilities of manipulation would have been greater, but was hampered by one proviso, upon which the Trustees of the institution insisted—that this should be the biggest instrument of its kind, and the instruction was obeyed. He had been requested by the gentlemen who had this enterprise in charge, to suggest, as a mark of respect to a gentleman of Albany, who was a munificent patron. of Science, that this instrument be known as the Olcott Meridian Circle. The other large instrument for the Observatory, the Heliometer, has been entrusted to an American artist, but is not yet completed. It was also announced that the American Astronomical Journal, hitherto supported at Dr. Gould's own expense, was in future to be published at Albany, under Dr. Gould's editorship, the responsibility of its cost having been assumed by a number of gentlemen of that City.

Among the Astronomical papers read before the Association was one by Dr. Peters on a *Periodical Comet of thirteen years.* This Comet was discovered by Dr. Peters, at Naples, in 1846. He has prepared an ephemeris of the Comet from 1857 to 1860. The comet was very difficult to observe; its light was so faint in 1846 that he could not perceive it until he had reposed his eye for some seconds in darkness. Even under these circumstances he had only seen it at intervals during a period of twenty days. He had devoted some time to calculating where the comet might be looked for on its re-appearance, and had drawn lines on a map, from eight days to eight days, so that the observer would be saved much of the labor of sweeping, and the comet could readily be discovered. The probable orbit gives an ellipse of thirteen years, with a probable error of one year, so that its period might be twelve or fourteen years. In 1854, Saturn came into nearly the same position as this comet, and some uncertainty exists as to its distance, it having been difficult to ascertain whether it was nearer the interior or the exterior of that planet. Unless some accident had happened, the comet might be looked for either fifty-six days before or fifty-six days after the 15th of March, 1859. This enquiry had become of more importance since two comets pronounced periodic, those of de Vico and Brünnow, had failed to re-appear. Dr. Peters remarked that the discovery of comets has decreased. Last year, not more than one or two were discovered. He thought this falling-off is owing partly to the fact that the award of a comet medal has been abandoned by the King of Denmark. For many years, the discoverer of any telescopic comet received a comet-medal from the King, but in 1848 the custom was abolished, and the zeal for discovery has since declined. He hoped the institution of the comet-medal would be renewed here.

Dr. Gould observed that it was not a little curious that since the establishment of the Observatory at Pultowa the realm of Denmark had contributed 200 per cent. more to the progress of astronomical science, in proportion to its population, than any other country. The comet medal, whose institution was suggested by Schumacher, continued to be awarded for fifteen years, during which period the discoveries of comets averaged five to seven per annum, and the average discover-

ies of each comet by independent observers three to four. Since it has been abolished the discoveries of comets have not averaged over three per annum, and the independent simultaneous discoveries of the same comet have become exceedingly rare.

THE UNITED STATES COAST SURVEY.

The progress of this magnificent work has furnished, as usual, many valuable results in Science since the preceding meeting of the Association; the following abstracts of the Papers read will shew how great credit is due both to the energy and skill of the conductors of this undertaking, and to the wise liberality of the Government which supports it.

"The Distribution of Terrestrial Magnetism in the United States," by Prof. Bache and J. D. Hilgard.

The magnetic observations made in connection with the Survey were scattered, at 160 different stations, along the entire sea coast, and the data were reduced to the common period of the year 1850. The line of no variation, or that passing through all the places where the magnetic needle points to the true north, intersects the coast near Ocracoke, between Cape Hatteras and Cape Fear, in a N.N.W. direction, curving gradually to the North, and passing through the middle of Lake Erie.

To the north and east of this line the declination (or variation of the compass) is to the west of north, being 6° near New York, 10° near Boston, and 16° in the eastern part of Maine. To the south and west of the line of no variation it is east of north, being 8° east along a line running directly south a little to the west of St. Louis and New Orleans, 13° near San Diego, and 21° near Cape Flattery on the western coast. The dip of the needle varies from 75° in the North eastern States to 60° along the northern shore of the Gulf of Mexico, and the horizontal force from 3.5 to 6.0 in the same regions.

SUPPLEMENT TO THE PAPER PUBLISHED IN THE PROVIDENCE PROCEEDINGS, ON THE SECULAR VARIATION IN MAGNETIC DECLINATION IN THE ATLANTIC AND GULF COAST OF THE UNITED STATES, FROM OBSERVATIONS IN THE SEVENTEENTH, EIGHTEENTH AND NINETEENTH CENTURIES, UNDER PERMISSION OF THE SUPERINTENDENT. BY CHAS. A. SCHOTT.

In a paper communicated to the Association at the Providence meeting the secular change of the magnetic declination was investigated by Mr. Schott. In the course of last summer he made some additional observations by direction of the Superintendent of the Coast Survey, and in the paper now presented the results are combined with those previously obtained. The former deductions have gained considerably in accuracy, and have received important additions. The number of stations is increased from ten to thirteen. The recent observations appear to show a slight diminution in the rate of increase of westerly declination, leading to the supposition that the inflexion in the curve representing the secular variation corresponds to about 1850. All the observations concur in placing the minimum about 1800. The present rate of increase of westerly declination is about five minutes annually along the Atlantic coast.

DISCUSSION OF THE SECULAR VARIATION OF MAGNETIC INCLINATION IN THE NORTH-EASTERN STATES. COMMUNICATED, UNDER PERMISSION OF THE SUPERINTENDENT AND AUTHORITY OF THE TREASURY DEPARTMENT, BY CHARLES A. SCHOTT.

The results are confined to the limits of 38 deg. and 44 deg. of North latitude, there being too few observations in the southern part of the United States to permit

safe inferences there. The element of magnetic dip, though less important practically than that of declination, is of value in navigation in certain latitudes, and from its connection, through Gauss' investigations, with the declination and intensity, assumes a high degree of importance. While the declination observations on this coast go back to the seventeenth century, the dip has only been accurately observed for 23 years; for the earliest observations made in 1782 were, from the imperfection of the instruments, of little value. During this period the dip has decreased, reached a minimum, and begun again to increase, so that it has been a highly interesting period for observation. The lines of equal dip have been deduced by Professor Loomis, from the observations which he had accumulated before the date of his paper. The present memoir includes additional results, and discusses 161 observations made at the different stations between Toronto on the north, and Baltimore on the south. The average probable error of the result at any one station is about one minute and six-tenths of dip, and the time of minimum dip is ascertained to be about two years and seven-tenths. This time was the year 1843, or rather the close of 1842 (1842–7). Mr. Schott points out why these results do not agree with Professor Hansteen's, who had not observations enough to determine the epoch of minimum dip with accuracy. Observations on the Western coast confirm these results for the Eastern.

ON THE CAUSE OF THE INCREASE OF SANDY HOOK. BY PROF. BACHE.

It is well known, as one of the developments of the Survey, that the Hook is gradually increasing, growing to the northward into the main ship channel. At a spot north of the Hook, where there were forty feet of water when Captain GEDNEY made his survey, in less than ten years it was nearly bare. The importance of determining the cause of this increase, as leading to the means of controlling it cannot be over estimated. The Commissioners on Harbor Encroachments had early attended to the matter and requested that the necessary observations for its investigation should be made. These were under the immediate direction of Prof. BACHE, the observations having been made by HENRY MITCHELL, one of the sub-assistants in the Coast Survey, with all desirable zeal and ability.

Various causes had been assigned for this growth from the action of the waves and the winds, sometimes on the outer side and sometimes on the inside of the Hook. The effect of the opening and closing of Shrewsbury inlet had also been insisted upon.

To examine these and other probable causes laborious observations of tides and currents had been made in the vicinity of stations which Prof. BACHE showed upon the map. Careful measurements of the low water line had also been made in connection with these observations, and with others of the force and direction of the winds. Objects easily distinguished from the sand, and of various specific gravities and shapes, had been deposited near the shore of the Hook to determine the power and direction of transportation of matter along the shores of the Hook. The results of these observations have not yet been worked out in all their detail, but the conclusions from them are perfectly safe, and are of the highest importance. It turns out that this growth of the Hook is not an accidental phenomenon, but goes on regularly and according to determinable laws. The amount of increase depends upon variable causes, but the general fact is that it increases year by year, and the cause of this is a remarkable northwardly current, the amount and duration of which these observations assign along both shores of the Hook, the outer one extending across the whole breadth of False Hook channel, with varying velocity, and the one

inside of the Hook extending nearly one-third of the distance across Sandy Hook Bay. These currents run to the north, during both the ebb and flood tide, with varying rates, and result from those tides directly and indirectly. The inner current is the one by which the flood and ebb tides draw, by the lateral communication of motion, the water from Sandy Hook Bay, and the outer is similarly related to those tides as they pass False Hook channel. The velocities and directions found, favor this conclusively.

An important observation for navigation results from this, for eleven hours out of the twelve, there is a northwardly current running through False Hook channel, which assists vessels entering New York harbor on the ebb tide, and is to be avoided in passing out with the ebb.

It is the conflict of these two northwardly currents outside and inside, and the deposit of the materials which they carry to the point of the Hook, which causes its growth.

Within a century it has increased a mile and a quarter, and at about the rate of one sixteenth of a mile a year, on the average, for the last twelve years.

Flynn's Knoll, on the north side of the main ship channel, does not give way, as the point of the Hook advances. The importance of watching this movement cannot, therefore be over stated.

The mode of controlling the growth is obvious from the result obtained. The observations are still continued, to obtain the necessary numerical results.

APPROXIMATE COTIDAL LINES OF DIURNAL AND SEMI-DIURNAL TIDES OF THE COAST OF THE UNITED STATES ON THE GULF OF MEXICO—BY A. D. BACHE, SUPERINTENDENT UNITED STATES COAST SURVEY. COMMUNICATED BY AUTHORITY OF THE TREASURY DEPARTMENT.

This paper is supplementary to those on cotidal lines of the Atlantic and Pacific coasts heretofore communicated to the Association. Preparation was made at the last meeting for these conclusions by presenting the type curves of the Gulf coast The tides from Cape Florida to St. George's are of the usual type, with a large daily inequality. From St. George's to the mouth of the Mississippi they are of the single day type. Then the half-day tides reappear to extend beyond Galveston, the day tides recurring at Aransas, in Texas, and southward. When the type curves were presented, the mode of decomposing them with a diurnal and semi-diurnal wave was described. The tide stations extend along our whole coast, but observations are much wanted beyond it to complete the investigation, on the south side of the Straits of Florida, on the eastern coast of the Gulf of Mexico south of Texas, and especially between Cuba and Yucatan, at the entrance of the Gulf from the Caribbean sea.

A table of the stations at which the observations were made, of the heights of tide (rise and fall) observed, and of the half-day and day tides, was given; and another showing the period of observation and the name of the observer. The first table is represented on a diagram by which a navigator may find the rise and fall of tide approximately on any part of our Gulf coast. The least observed rise and fall is at Brazos Santiago, Texas, and is nine tenths of a foot. The greatest is at Cedar keys, Florida, and is two and a half feet. The difficulties of the problem presented by these tides are explained, removable in part by the progress of the survey of the Gulf, inherent in them in part. The labors of Mr. Pourtales and other gentlemen concerned in the discussion of these tides are acknowledged. The single-day tides have not been so elaborately discussed by former physicists or mathe-

maticians as to prepare the way fully for this work. The formula for the times given by Professor Avery in his "Tides and Waves," when compared with the observed times, differs remarkably in certain parts of the lunar month. A diagram shows the general form of the curve of interval between the moon's transit and high water. Advantage is taken of the part of the curve which changes but little in ordinate to obtain an average luni-tidal interval corresponding in kind with the number for semi-diurnal tides, known at the establishment. These tides occur about the period of greatest declination of the moon. These intervals, at greatest declination, vary greatly during the year; and the form of curve showing the annual change is presented, as deduced from observations at key West, Fort Morgan (Mobile entrance), and Galveston, as well as from San Francisco, on the Western coast, where the results are remarkably regular. These annual curves are used to deduce the average number for the interval of the daily tides from the short series of observations; the limits of uncertainty of the process are pointed out. These intervals are next turned into cotidal hours by the usual process of correcting for the difference of longitude, for transit, for depth, and by the process just described for the annual change. A table of cotidal hours for the various stations is then given. By it the cotidal lines are traced, the tide waves entering the Straits of Florida, passing through them, crossing to the entrance of the Mississippi, and passing laterally to the western coast of the peninsula of Florida from south to north, and along the southern coast of Upper Florida, along the eastern coast of Louisiana from the Southwest Pass northward, and along the coast of Mississippi. Also, into the Gulf between Southwest pass and the Rio Grande, in such a way that Galveston has, as the head of the Gulf, the latest cotidal hour. By forming groups of stations, the direction of the cotidal lines, the mean cotidal hour, and the velocity of the wave's movement are roughly determined. The difficulties of forming the groups are explained, and the general character of the results given by them are shown in a table and upon a diagram map. Upon the map also are given the cotidal hours of the stations, and the results of the grouping. Finally, from the study of the groups and their connection, the cotidal lines or the daily tides are drawn upon the map. The main cotidal hour of the northern shore of the Gulf is twenty-six hours, twenty seven occurring at the head of the bight in which Galveston lies. The twenty-five hour line appears at Cedar Keys, and touches the coast again at Brazos Santiago. Twenty-three is at the Tortugas and Key West, and nineteen at Cape Florida.

A similar course to that just described is followed in the discussion of the semi-diurnal tides. The table of stations, their positions, and the other data necessary to obtain cotidal hours is given. The progress of the semi-diurnal wave as indicated by three hours is also shown. The general motion of the wave is like that of the diurnal wave, with very characteristic peculiarities. From the line of deep water joining the Tortugas and Southwest Pass at the entrance of the Mississipi the semi-diurnal wave reaches the stations on the western coast of the Florida peninsula in this order, from south to north and west. The movement west of St. George's appears to be in the order of Pensacola, Fort Morgan and Cat Island, while for the diurnal wave it was Cat Island, Fort Morgan, Pensacola. To the westward of Southwest Pass there is a sudden increase of estabiishment, as if another semi-diurnal wave brought the tides there. The mean cotidal hour of the five sections west of Southwest Pass is 20 h. 6 m., while that of Southwest Pass and three east of it is 16 h. 17 m., a difference of about four hours. This taken with

the remarks already made in regard to the appearance of two high waters in the curves for Isle Dernier and Calcasieu, indicate a system of interferences yet to be unravelled. As was the case with the diurnal wave, the stations at Isle Dernier and Calcasieu gave cotidal hours very like those of Brazos Santiago and Aransas, and Galveston is later then either.

The differences between the cotidal hours for the diurnal and semi-diurnal tides are shown in a table. The grouping of the semi-diurnal results is next made, and the results tabulated and drawn on a diagram map. This map also shows the cotidal lines deduced. The cotidal lines of thirteen and fourteen hours only appear on the coast of the Florida Keys; that of sixteen hours is well marked, near Egmont Key (Tampa), and passes around the shore of the great Bay, between Louisiana and Florida, to near Southwest Pass. The line of eighteen hours is at the head of the heights, between St. George's and Cedar keys, and seventeen in that near Cat Island; the lines of sixteen and twenty-one have succeeded each other closely in the bay to the westward of Southwest Pass.

In comparing the two sets of cotidal lines for the diurnal and semi-diurnal waves, we find a general resemblance in the great bay between the western coast of Florida and the eastern coast of Louisiana. The lines of 24, 25 and 26 of the diurnal tide on the eastern side of the bay, corresponding generally with 16, 17 and 18 of the semi-diurnal tides and 25 and 26 hours of the diurnal tide on the western side of the bay corresponding generally to 16 and 17 of the semi-diurnal. On the southern coast of Florida, by the Keys, on the contrary the lines of 19, 20, 21, 22 and 23 hours succeed each other rapidly between Cape Florida and the Tortugas, in the diurnal series, along the same shores in the semi-diurnal tide. On the contrary on the west of southwest Pass, the lines of 26, 27 and 28 hours only occura t considerable distances in the diurnal system, while 16, 17, 18, 19, 20 and 21 occur in the same space between Southwest Pass and Brazos Santiago in the same diurnal tide.

NOTES ON THE PROGRESS MADE IN THE COAST SURVEY, IN PREDICTION TABLES FOR THE TIDES OF THE UNITED STATES COAST, BY A. D. BACHE, SUPTD., ETC.

Communicated by authority of the Treasury Dept.

As soon as tidal observations had accumulated sufficiently to make the task a profitable one, I caused them to be treated, under my immediate direction, by the methods in most general acceptance. The observations at Old Point Comfort, Virginia, were among the earliest used for this purpose, and the labors of Commander Charles H. Davis, U. S. N., then an assistant in the coast survey, were directed to their reduction chiefly by the graphical methods pointed out by Mr. Whewell. This work was subsequently continued by Mr. Lubbock's method, by Mr. Henry Mitchell; and next the tides of Boston harbor were taken up as affording certain advantages in the observations themselves, which could not be claimed for those of Old Point.

The system of Mr. Lubbock is founded on the equilibrium theory, and in it the inequalities are sought by arranging the elements of the moon's and sun's motions, upon which they depend. Having obtained the coefficient of the half monthly inequality of the semi-diurnal tide at Boston, from seven years' observations, through the labors of the tidal division, and approximate corrections for the parallax and declination, I was much disappointed in attempting the verification by applying to individual tides for a year during which we had observations. There was a general agreement on the average but a discrepancy in the single cases, which was quite

unsatisfactory. Nor were these discrepancies without law, as representing their residuals by curves did not fail to show. By introducting corrections for declination and parallax of the moon increasing and decreasing, we reduced these discrepancies, but still the results were not sufficient approximations. With the numerical reductions of the observations before referred to, was commenced in 1853, under my immediate direction, by Mr. L. W. Meech, a study of the theory of the tides, directed chiefly to the works of Bernoulli, La Place, Avery, Lubbock and Whewell. The immediate object which I had in view was the application of the wave theory to the discussion of our observations. I thought that the mind of an expert mathematician, directed entirely to the theoretical portions of this work, with direction-by a physicist, and full opportunities of verifying results by extended series of observations, the computations of which should be placed by others in any desired form, would give, probably, the best result in this combined physical and mathematical investigation.

The general form of the different functions expressing the tidal inequalities is the same in the different theories, and may be said on the average to be satisfactory as to the laws of change which these inequalities present. Whether we adopt, with La Place, the idea that periodical forces produce periodical effects, or with Avery, that the tidal wave arrives by two or more canals; or with Bernoulli and Lubbock, the results of an equilibrium spheroid; or with Whewell, make a series of inequalities, semi-menstrual, parallax and declination, with different epochs, we arrive at the same general results, that the heights and times of high water may be represented by certain functions, with indeterminate co-efficients, in the form of which the theories in a general way agree. By forming equations from the observations, and obtaining the numerical values of the co-efficients by the methods used so commonly in astronomical computations, the result is accomplished.

A general consideration of the co-ordinates in space of the moon and sun, without any special theory, would lead to the same result, representing the luni-tidal interval by a series of sines and co-sines, with indeterminate co-efficients.

The grouping of the observations of one year at Boston, to apply this method-the formation of the equations and their solution by the method of indirect elimination has been the work of Mr. R. L. Avery.

To test the co-efficients, computations, for the predicted times of the tide at Boston harbor were made for a period from March 1853, to January 1854, and from comparison of these with the observed, it appears that in twenty pairs of tides, the morning and afternoon being grouped to get rid of the diurnal inequality, there are two differences of less than two 2 m., thirteen of more than 2 m. and less than 4 m., three of more than 4 m. and less than 10 m., two of more than 10 m. The probable error of the prediction of a single pair of tides is 4.12 m. so that greater accuracy of prediction has been attained by this method from a single years's observations that was found at London bridge from a period of nineteen years.

LAW OF MORTALITY.

Prof. McCoy, of Albany, read a paper in which he announced the important discovery of a mathematical formula which correctly expressed the law of mortality for all ages; it was first evolved from an analysis of the Carlisle and Northampton tables, but the Professor had compared it with a large number of others and said that, "so complete is its agreement with all, that at no age does the calculated number of the living differ from the number given in the tables by

a single year's mortality." The formula is, that, for the age x, the rate of mortality or the ratio of the dead to the living for that age is expressed by

$$a\,b^{c^{x}}$$

where, a, b, c, are constants which differ for different tables. From this the Professor drew the following conclusions;

1. The rate of mortality invariably increases from youth to old age.
2. This rate is continually accelerated even in a higher ratio than in geometrical progression.
3. In early manhood, the rate does not differ much from a slow arithmetical progression.
4. There are no crises or climacterics at which the chances for life are stationary or improving.
5. There are no periods of slow and rapid increase succeeding each other; but one steady, invariable progress.
6. The law, though not the rate of mortality, is the same for city and country, for healthy and unhealthy places, for every age and country and locality; and this law is that the differences of the logarithms of the rates of mortality are in geometrical progression.

OZONE OBSERVATION.

Prof. Rogers gave an account of some observations made by him on the existence of ozone in the atmosphere. In the first instance these were made at Boston, and he here found winds blowing from the sea heavily ozonised, while those from the land were less so; on removing, however, fifty miles inland, he found the indications of ozone apparently independent of the quarter from which the wind was blowing, and depending more on its velocity; in a calm there being but slight ozonic effect, the increase being marked with the violence of the wind. This was to have been expected from the imperfect character of the mode of observation, since the effect produced on the test paper would depend on the quantity of ozone brought in contact with it, and this of course depended on the quantity of air that passed over it in a given time. To remedy this defect, he had arranged an apparatus by which the number of cubic feet of air passing over the test paper could be measured.

Dr. Webster, of Norfolk, added an important observation, "*Last year, while the yellow fever was at Norfolk and Portsmouth, I kept an ozonometer constantly exposed to the air, and never detected ozone. This year I have used the ozonometer in the same place, and at the same period of time, and I find ozone in abundance.*"

THERMIC EFFECT OF THE SUN'S RAYS.

In a paper, by Mrs. Eunice Foote, some interesting results of experiments on this subject were given. The experiments were made by exposing freely to the Sun's rays a thermometer, with blackened bulb, enclosed in a glass receiver, which contained the various gases experimented on. The effect was found to be greatest of all in Carbonic Acid gas: for example, when in air the thermometer stood at 106°, in Hydrogen it stood at 104°; in Oxygen, at 108°, and in Carbonic Acid at 125°. It was also found that the thermic effect was increased in air by an increase of its density and also by an increase of the moisture in it.

(*To be continued.*)

MONTHLY METEOROLOGICAL REGISTER AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST, OCTOBER, 1856.

Latitude—43 *deg.* 39.4 *min. North. Longitude*—79 *deg.* 21 *min. West. Elevation above Lake Ontario,* 108 *feet.*

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Mean Temp. + or — of the Av'age.	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resul't. Direc. tion.	Direction of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M	2 P.M	10PM	ME'N		6 A.M	2 P.M	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A. M.	2 P. M	10 P. M.		6 A.M	2 PM.	10 P.M.	Re-sult'.	ME'N		
1	29.225	29.263	29.335	29.2805	40.0°	50.0°	43.0°	44.63°	— 5.78°	.213	.218	.200	.212	.87	.61	.72	.73	s w b w	s w b w	s w b s	s 38° w	2.8	13.6	6.0	9.89	10.08	...	...
2	343	395	544	.4412	45.1	51.7	45.8	47.47	— 2.47	177	232	248	217	60	62	82	68	s w b s	s s w	s w	s 50 w	13.5	17.8	1.8	8.24	9.59	...	...
3	693	718	788	.7380	38.4	57.9	47.4	48.53	— 1.00	197	237	220	217	85	50	68	66	w n w	s w b s	s w	s 47 w	7.0	8.3	2.5	3.68	4.79	...	...
4	841	786	732	.7833	42.0	57.2	51.0	50.95	+ 1.92	235	288	305	285	89	62	83	78	n	e	n e b e	n 71 e	1.0	6.4	1.4	2.83	3.04	...	...
5	704	628	—	—	43.4	63.2	—	—	—	256	398	—	—	92	70	—	—	Calm	s b w	s w b w	s 58 w	0.0	4.8	2.0	2.52	4.11	Inap	...
6	728	781	896	.8092	54.2	62.0	49.2	54.78	+ 6.57	283	274	297	282	69	51	86	69	n w b w	n b w	n b w	n 20 w	5.6	11.6	7.2	7.24	7.48	...	...
7	969	952	894	.9362	41.1	51.9	42.8	46.07	— 1.78	216	278	247	249	84	73	91	81	n b e	s e b e	Calm	n 73 e	2.8	3.6	0.0	2.37	2.73	...	...
8	892	840	822	.8492	39.8	59.4	48.1	49.67	+ 2.22	220	359	294	295	91	72	89	84	Calm	s	Calm	s 32 e	0.0	2.2	0.0	0.58	0.76	...	...
9	853	798	801	.8152	45.2	70.1	55.3	56.72	+ 9.65	279	383	355	337	94	54	83	77	Calm	s	e b s	s 62 e	0.0	1.0	1.5	0.59	0.82	...	...
10	821	769	719	.7672	44.9	67.3	50.6	54.83	+ 8.17	287	346	253	314	97	53	70	76	n e b n	Calm	Calm	s 62 e	1.5	0.0	0.0	0.45	0.51	...	...
11	724	779	873	.7992	52.1	64.9	50.8	56.42	+10.17	291	242	281	281	76	40	77	65	s s w	n w	n	n 19 w	1.4	12.4	10.3	7.96	9.13	...	...
12	29.822	790	—	—	45.4	54.6	—	—	—	209	312	—	—	70	75	—	—	n n e	s e	e	s 79 e	1.0	4.5	0.8	0.86	1.08	0.115	...
13	616	635	806	.6960	51.0	53.9	40.6	48.07	+ 2.50	344	216	127	223	97	53	50	65	Calm	n w b n	n	s 20 e	0.0	21.8	16.8	12.49	13.54	Inap	...
14	956	979	30.080	30.0198	35.2	39.9	33.7	36.32	— 8.95	114	110	106	119	56	45	55	55	n b e	n n e	n b e	n 10 e	9.2	10.0	6.6	9.74	9.96	...	...
15	30.175	30.128	30.088	30.1325	28.4	43.4	31.6	35.17	— 9.68	110	163	144	140	70	59	80	69	n b e	s	Calm	n 43 w	6.7	2.4	0.0	0.22	2.50	...	...
16	30.052	29.951	29.900	29.9617	27.3	48.9	38.8	38.57	— 5.97	130	224	177	177	86	65	75	75	Calm	s w b s	n n w	s 83 w	0.0	7.8	4.8	1.49	3.48	...	...
17	29.888	29.823	705	.7905	37.0	51.3	46.7	44.90	+ 0.67	174	302	274	248	80	81	87	83	n	e n e	n b e	n 49 e	4.7	8.3	2.8	5.83	6.40	0.365	...
18	610	608	705	.6437	45.6	47.9	47.3	47.05	+ 3.02	288	289	290	291	95	89	90	91	n e	n n w	w n w	n 32 w	6.4	9.2	0.4	3.47	4.46	0.225	...
19	835	859	—	—	44.2	53.3	—	—	—	268	321	—	—	93	81	—	—	Calm	s w	Calm	s 60 w	0.0	3.0	0.0	0.72	0.77	0.010	...
20	952	891	913	.9170	37.5	53.8	40.4	44.05	+ 0.48	214	331	237	267	96	82	95	93	Calm	Calm	Calm	s 33 w	0.0	0.0	0.0	0.04	0.04	...	...
21	891	802	690	.7892	38.4	52.6	48.5	46.70	+ 3.45	217	326	295	283	94	84	88	89	Calm	Calm	Calm	n 66 w	0.0	0.0	0.0	0.13	0.14	...	...
22	607	537	553	.5610	54.2	59.3	52.8	55.17	+12.20	367	418	313	366	89	85	80	85	Calm	n	n n w	n 25 w	0.0	0.8	11.4	4.40	4.63	0.025	...
23	635	714	883	.7545	44.9	44.9	33.4	40.97	— 1.78	248	132	108	167	84	45	57	64	n b e	n n w	n b e	n 23 w	0.5	21.8	9.2	9.82	10.40	...	...
24	989	957	943	.9513	23.3	38.4	30.5	31.52	—10.98	107	124	134	121	83	54	79	69	n	s e	e b n	n 83 e	1.4	8.5	1.1	3.28	4.36	...	...
25	830	696	690	.7407	38.8	42.1	42.1	40.60	— 1.68	169	166	183	167	73	63	69	67	e b s	e s e	Calm	s 82 e	13.9	14.2	0.0	7.64	7.68	0.010	...
26	818	778	—	—	38.8	50.8	—	—	—	260	288	—	—	85	78	—	—	Calm	s b w	s b w	s 32 w	0.0	6.0	1.2	1.85	2.45	...	...
27	519	350	403	.4202	46.0	46.0	45.2	45.47	+ 3.68	279	292	270	281	90	95	90	93	s s w	e n e	w b s	s 54 w	4.0	2.0	19.0	4.38	7.39	0.105	...
28	355	324	451	.3838	37.3	45.9	40.7	41.90	+ 0.42	193	163	178	176	87	53	71	68	s w b w	w s w	w s w	s 73 w	4.0	21.5	14.5	15.12	15.17	...	...
29	523	466	234	.4048	41.5	47.4	47.0	45.45	+ 4.18	244	186	267	233	94	57	84	78	w s w	s w	e s e	s 43 w	8.5	10.0	4.6	9.33	11.45	0.020	...
30	274	288	345	.3023	42.0	39.4	34.5	38.22	— 2.73	247	116	157	166	94	48	78	72	s w	w b s	s w b w	s 76 w	12.6	21.0	12.0	13.99	14.17	...	Inap
31	329	384	464	.3970	31.2	35.0	35.1	34.13	— 6.62	154	127	119	132	88	62	58	68	w *b* s	w b n	s w b w	s 75 w	10.4	14.5	9.6	13.99	14.89	...	0.1
M	29.7145	29.6894	29.7132	29.7069	40.83	51.20	43.44	45.34	+ 0.30	.222	.242	.225	.231	.85	.63	.77	.75	....	....	....	....	3.84	8.68	4.76	......	6.07	0.875	0.1

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR OCTOBER.

Highest Barometer . . . . 30.200 at 8 a. m. on 15th } Monthly range=
Lowest Barometer . . . . 29.217 at midn't. on 29th } 0·983 inches.

Highest registered temperature . . . . 71°4 on p. m. of 9th } Monthly range=
Lowest registered temperature . . . . 23°0 on a. m. of 24th } 48°4

Mean maximum temperature . . 54°04 } Mean daily range = 18°82
Mean minimum temperature . . 35°22 }

Greatest daily range . . . . 28°5 from p. m. of 13th to a. m. of 14th.
Least daily range . . . . 6°4 from p. m. of 18th to a. m. of 19th.

Warmest day . . 9th ... Mean Temperature . . . 56°72 } Difference=25°20.
Coldest day . . . . 24th ... Mean Temperature . . . 31°52 }

Greatest intensity of Solar Radiation . . 88°4 on p. m. of 9th } Monthly range=
Lowest point of Terrestrial Radiation . 7°5 on a. m. of 24th } 80°9

Aurora observed on 3 nights, viz.: on the 4th, 8th and 23rd; possible to see Aurora on 19 nights; impossible to see Aurora on 12 nights.

Snowing on 2 days; depth, 0.1 inches; duration of fall, 1.5 hours.

Raining on 10 days; depth, 0.875 inches; duration of fall, 27.8 hours.

Mean of cloudiness=0.47; most cloudy hour observed, 4 p. m., mean=0.53: least cloudy hour observed, midnight; mean=0.40.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
1562.21	1187.47	703.87	2263.32

Resultant direction of the wind, N 76° W; Resultant Velocity, 2.15 miles per hour.

Mean velocity of the wind . . . . 6.07 miles per hour.
Maximum velocity . . . . 27.4 miles per hour, from 3 to 4 p.m. on 13th.

Most windy day . . . . 28th—Mean velocity, 15.17 miles per hour.
Least windy day . . . . 20th—Mean velocity, 0.04 do

Most windy hour . Noon to 1 p. m—Mean velocity, 9.82 do } Difference
Least windy hour 11 p. m. to midnight.—Mean velocity, 3.86 do } 5.96 miles.

1st to 2nd. Hoar Frost on these mornings at 6 a. m.

4th. Sheet Lightning, not accompanied by Thunder, during the Evening.

10th. Very dense ground Fog at 6 a. m.

" Small halo round the Moon at 10 p. m.

14th and 15th. Thin Ice on the water at 6 a. m.
19th to 22nd inclusive. Extraordinary and continuous dense Fog.
22nd. Sheet Lightning and distant Thunder 8 to 11 p. m.
30th. First Snow of the Season at 11 a. m.
31st. Snowing slightly most of the day.

This month was marked by an unusual scarcity of rain, the quantity that fell having been less than one-third of the average.

The Resultant direction of the Wind for October, from 1848 to 1856 inclusive, was N 63° W, and the Resultant velocity 1.35 miles per hour.

COMPARATIVE TABLE FOR OCTOBER.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	No. of dy's.	Inches.	No. of dy's.	Inches.	Resultant. Direction.	Resultant. Velocity.	Mean Velocity
1840	° 44.4	° — 0.8	° 23.9	° 20.9	° 44.6	13	1.860	3	—	° —	—	—
1841	41.6	— 3.6	58.3	20.3	38.0	6	1.360	2	—	—	—	0.41 lbs.
1842	45.1	— 0.1	68.5	30.0	38 5	8	5.175	0	—	—	—	0.35 "
1843	41.8	— 3.4	65.7	24.5	41.2	12	3.790	4	2.5	—	—	0.54 "
1844	43.3	— 1.9	69.6	17.8	51.8	7	Impft	4	12.0	—	—	0.43 "
1845	46.4	+ 1.2	62.7	20.0	42.7	11	1.760	1	Inapp	—	—	0.26 "
1846	44.6	— 0.6	69.7	20.7	49.0	14	4.180	2	Inapp	—	—	0.44 "
1847	44.0	— 1.2	65.0	20.3	44.7	13	4.390	2	Inapp	—	—	0.19 "
1848	46.3	+ 1.1	62.2	26.4	35.8	11	1.550	0	0.0	N 54 W	1.24	4.60 mls.
1849	45.3	+ 0.1	59.2	25.5	33.7	13	5.965	1	Inapp	N 12 W	1.27	4.76 "
1850	45.4	+ 0.2	66.6	24.8	41.8	10	2.085	0	0.0	N 66 W	1.10	5.30 "
1851	47.4	+ 2.2	66.1	25.0	41.1	10	1.680	2	0.3	S 72 W	1.06	4.39 "
1852	48.0	+ 2.8	70.7	29.8	40.9	12	5.280	0	0.0	N 5 E	1.19	4.47 "
1853	44.4	— 0.8	64.7	25.5	39.2	10	0.875	2	Inapp	S 87 W	1.52	4.72 "
1854	49.5	+ 4.3	74.2	29.8	44.4	15	1.495	3	Inapp	N 25 E	1.18	4.60 "
1855	45.4	+ 0.2	64.3	28.0	36.3	14	2.485	5	0.8	N 82 W	4.91	9.88 "
1856	45.3	+ 0.1	70.1	23.3	46.8	10	0.875	2	0.1	N 76 W	2.15	6.07 "
Mean	45.19	...	66.24	24.45	41.79	11.1	2.800	1.9	1.1	—	—	5.42

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY TORONTO, CANADA WEST—NOVEMBER, 1856.

Latitude—43 *deg.* 39.4 *min. North.* *Longitude*—79 *deg.* 21 *min. West.* *Elevation above Lake Ontario,* 108 *feet.*

Day.	Barom. at temp. of 32°. 6 A.M.	2 P.M.	10 P.M.	MEAN	Temp. of the Air. 6 A.M	2 P.M	10PM	ME'N	Mean Temp. + or — of the Av'age.	Tens. of Vapour. 6 A.M	2 P.M	10 P.M	M'N	Humidity of Air. 6 A.M	2 P.M	10 P.M	M'N	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Mean Direc-tion.	Velocity of Wind. 6 A.M	2 P.M	10PM	Re-sul't.	ME'N	Rain in Inches.	Snow in Inches.
1	29.227	29.067	29.279	29.1908	39.5°	53.1°	41.0°	44.05°	+ 3.58°	.146	.225	.215	.200	.60	.56	.84	.69	S S W	W S W	W	S 54° W	19.7	22.1	3.0	9.42	10.75	...	...
2	.372	.427	—	—	42.7	51.0	—	—	—	.223	.269	—	—	.82	.73	—	—	N b W	S	S W	S 40 W	2.2	5.1	0.6	2.20	3.74	0.175	...
3	.623	.445	.408	.4880	48.8	49.5	49.9	48.98	+ 8.98	.321	.298	.337	.314	.94	.85	.97	.92	E b N	E	Calm.	N 88 E	7.8	8.0	0.0	3.88	3.93	0.205	...
4	.291	28.902	.292	.1780	51.0	56.4	34.8	46.02	+ 6.25	.353	.344	.115	.256	.96	.76	.55	.76	E b S	S S W	W N W	S 78 W	4.4	20.0	31.5	14.96	20.93	...	...
5	.591	29.802	30.004	.8223	26.4	32.5	25.1	27.92	—11.57	.106	.090	.094	.098	.72	.49	.67	.64	W	N W	W N W	N 65 W	18.6	16.2	3.0	10.49	10.95	...	...
6	30.041	.940	29.814	.9255	22.8	40.3	39.9	35.43	— 3.73	.106	.148	.196	.157	.84	.59	.81	.75	Calm.	S b W	S b E	S 5 W	0.0	19.6	6.0	8.36	8.70	...	...
7	29.772	.725	.613	.6943	42.7	49.3	50.3	47.72	+ 8.72	.240	.242	.266	.251	.89	.70	.73	.77	S b E	S	S b E	S 1 E	7.0	9 0	6.2	6.17	6.59	0.180	...
8	.283	.684	.929	.6308	50.6	38.8	28.4	39.32	+ 0.63	.338	.141	.136	.204	.93	.60	.87	.78	S b E	W	N W b N	S 86 W	12.2	30.6	2.0	10.77	13.85	0.045	Inap
9	.922	.878	—	—	29.6	33.0	—	—	—	.125	.131	—	—	.76	.69	—	—	N W b N	W	N W b W	N 76 W	5.4	7.4	9.5	5.33	5.64	...	...
10	.914	.893	.823	.8738	24.8	35.9	37.3	33.15	— 4.93	.108	.120	.156	.133	.79	.57	.71	.70	N W b W	S E b S	S S E	S 33 E	1.4	8.0	6.5	5.05	6.37	...	...
11	.755	.761	.823	.7813	39.5	43.7	40.2	40.35	+ 2.57	.204	.171	.176	.187	.85	.61	.72	.76	S S W	S S W	W b N	S 72 W	11.2	4.5	5.1	2.42	3.74	...	...
12	.851	.833	882	.8605	36.7	43.6	36.9	38.70	+ 1.20	.178	.158	.148	.171	.82	.55	.68	.73	N W b N	W N W	W b N	N 69 W	3.5	12.0	9.0	8.82	9.05	...	0.1
13	.871	.788	.740	.7892	33.0	38.8	36.1	36.03	— 1.15	.175	.216	.184	.187	.94	.93	.87	.89	W S W	S b E	N E b E	N 88 E	1.1	0.8	2.8	3.00	5.48	0.290	0.5
14	.656	.691	.795	.7195	34.5	38.4	34.8	35.67	— 1.23	.194	.167	.169	.171	.98	.72	.84	.83	N E	N	N b W	N 6 E	12.3	13.5	8.5	9.74	10.78	0.055	0.5
15	.763	.583	.372	.5577	24.1	36.6	39.0	33.70	— 2.80	.115	.136	.174	.153	.86	.63	.74	.78	N W b N	S S W	S	S 25 W	5.2	9.0	12.5	6.61	8.22	0.015	...
16	.257	.312	—	—	39.1	41.6	—	—	—	.221	.200	—	—	.94	.76	—	—	S W	W b S	W N W	S 89 W	9.0	19.0	9.5	9.73	10.58	...	0.6
17	.392	.473	.635	.5120	27.3	32.3	30.2	29.77	— 6.03	.126	.116	.145	.133	.85	.64	.86	.81	N W b N	W	N W b W	N 65 W	9.0	16.2	10.0	10.91	11.08	...	0.1
18	.729	.757	.807	.7643	30.9	35.6	32.0	32.95	— 2.53	.158	.144	.141	.143	.93	.69	.78	.76	W N W	N W b W	W	N 74 W	16.5	17.2	3.6	8.73	9.05	...	...
19	.852	.858	.936	.8885	27.3	38.1	29.5	32.03	— 3.05	.131	.139	.138	.136	.86	.61	.84	.76	W b S	W	Calm.	N 88 W	1.9	3.3	0.0	0.12	1.33	...	...
20	.991	.980	.957	.9717	31.7	36.5	35.9	34.85	+ 0.05	.149	.157	.164	.160	.83	.73	.78	.79	Calm.	E	E	N 80 E	0.0	5.0	5.8	5.73	5.79	...	...
21	.807	.554	.227	.5152	37.3	40.3	46.3	41.55	+ 7.17	.195	.195	.266	.219	.88	.79	.86	.83	E b N	E	E	S 55 E	14.8	15.6	4.0	6.83	16.54	0.195	...
22	.437	.707	.860	.6933	44.9	42.0	33.8	39.68	+ 5.60	.252	.156	.147	.171	.85	.59	.75	.70	S W	W S W	Calm.	S 62 W	25.0	17.2	0.0	10.07	10.09	...	...
23	.897	.690	—	—	32.0	40.9	—	—	—	.153	.212	—	—	.85	.84	—	—	Calm.	E N E	N E b E	N 67 E	0 0	8.3	1.5	4.89	5.33	...	...
24	.594	.695	.790	.7050	34.8	45.4	40.4	39.52	+ 6.25	.185	.218	.185	.192	.92	.72	.74	.80	Calm.	N N W	Calm.	N 10 E	0.0	4.0	0.0	0.78	1.07	...	...
25	.763	.464	.245	.4720	39.5	39.8	41.3	40.58	+ 7.62	.208	.214	.247	.228	.87	.88	.97	.91	E b N	E b N	E b N	N 83 E	9.0	20.6	3.0	9.46	13.53	0.215	...
26	.324	.503	.631	.5048	45.2	44.5	38.8	41.87	+ 9.30	.211	.161	.224	.194	.71	.56	.95	.75	W b S	W	W	S 80 W	20.7	26.2	3.5	13.09	13.18	Inap	...
27	.594	.565	.598	.5900	37.7	40.2	29.3	35.20	+ 3.02	.169	.129	.126	.136	.75	.51	.78	.67	W b S	W b N	W b S	S 80 W	10.0	20.2	3.6	10.16	10.29	...	...
28	.626	.592	.512	.5740	29.4	33.9	35.2	33.13	+ 1.25	.145	.146	.158	.148	.89	.74	.78	.78	W b N	E b N	E	N 74 E	3.0	8.3	12.0	7.69	9.17	...	3.5
29	.279	.260	.495	.3485	9.1	26.1	26.9	26.57	— 4.93	.142	.130	.131	.130	.88	.89	.88	.88	N E b E	N N W	N N W	N 1 W	20.2	11.0	1.0	6.02	8.19	...	4.2
30	.630	.802	—	—	27.8	34.8	—	—	—	.129	.157	—	—	.84	.77	—	—	W b S	W N W	W N W	N 72 W	8.5	15.8	5.0	7.32	8.71	...	Inap
M	29.6410	29.6211	29.6587	29.6421	35.58	40.46	36.54	37.39	+ 1.24	.186	.174	.178	.179	.85	.68	.80	.78					8.65	13.12	5.62		8.75	1.375	9.5

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR NOVEMBER.

Highest Barometer .... 30.048 at 8 a. m., on 6th } Monthly range=
Lowest Barometer .... 28.902 at 2 p. m., on 4th } 1.146 inches.

Highest registered temperature......... 56°4 at p. m., on 4th } Monthly range=
Lowest registered temperature......... 18°8 at a. m., on 6th } 37°6

Mean maximum Thermometer......... 43°02 } Mean daily range = 14°27
Mean minimum Thermometer......... 28°74 }

Greatest daily range .... 32°4 from p. m. of 4th to a. m. of 5th.
Least daily range.................................. 6°1 from a. m. of 20th to a. m. of 21st.

Warmest day......... 3rd ... Mean temperature......... 48°98 } Difference = 22°41.
Coldest day........... 29th ... Mean temperature......... 26°57 }

Greatest intensity of Solar Radiation .... 67°5 on p. m. 4th } Monthly range=
Lowest point of Terrestrial Radiation .... 5°8 on a. m. 6th } 61°7

Auroral Light observed on 1 night, viz., 4th; possible to see Aurora on 10 nights; impossible to see aurora on 20 nights.

Snowing on 9 days.—depth 9.5 inches—snowing 30·2 hours.
Raining on 10 days,—depth 1.375 inches—raining 42.3 hours.

Mean of cloudiness =0.81; most cloudy hour observed, 8 a. m., mean =0.91; least cloudy hour observed, 10 p. m., mean, =0.74.

Sum f the Atmospheric Current, in miles, resolved into the four Cardinal directions.

North.	South.	East.	West.
1296.20	1491.66	1428.63	3539.50

Resultant direction of the wind, S 85° W.; Resultant Velocity 2.95 miles per hour.
Mean velocity of the wind......... 8.75 miles per hour.
Maximum velocity .... 40.8 miles per hour, from 4 to 5 p. m. on 4th.
Most windy day......................... 4th...Mean velocity 20.93 miles per hour.
Least windy day .... 24th...Mean velocity 1.07 ditto.
Most windy hour ... 2 to 3 p. m.............Mean velocity 13.29 ditto.
Least windy hour, Midnight to 1 a.m. ...Mean velocity 5.70 ditto.
Mean diurnal variation = 7.59 miles.

4th—Dense Fog, 6 to 8 a. m.
4th—Auroral Light at Midnight.
6th—Halo round the Moon, 7 to 9 p. m.
8th—Zodaiacal Light, very bright, 5.30 to 6 p. m.
10th—Halo round the Moon, 8 to 9 p. m.
15th—Halo round the Sun, and faint Parhelion at 2 p. m.
25th—Dense Fog at Midnight.
30th—First Sleighing in Toronto this Season.

Rain—The scarcity shown by the record of October, continued to a great extent through November, the amount that fell in November having been less than half the average.

Wind—The mean velocity of the wind was 2.23 above the average, and was but once exceeded during the last nine years.

The Resultant Direction of the wind for November of the last nine years was N 70° W, and the resultant velocity 1.84 miles per hour.

COMPARATIVE TABLE FOR NOVEMBER.

Year.	Temperature.					Rain.		Snow.		Wind.		
	M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range.	Days.	Inch's.	Days.	Inch's.	Resultant. Direction.	Resultant. V'y.	Mean Force or Velocity.
1840	° 35.9	° —0.9	° 54.4	° 20.5	° 33.9	5	1.220	8	...	...	...	....
1841	35.0	—1.8	63.2	7.6	55.6	8	2.450	5	...	...	...	0.91 lb
1842	33.3	—3.5	50.6	7.6	43.0	9	5.310	10	...	...	...	1.22 "
1843	33.5	—3.3	51.2	14.4	36.8	10	4.765	7	1.2	...	...	0.59 "
1844	34.9	—1.9	49.8	12.0	37.8	8	imper	4	8.0	...	...	0.48 "
1845	36.8	0.0	58.8	7.6	51.2	7	1.105	4	5.0	...	...	0.53 "
1846	41.3	+4.5	55.5	18.2	37.3	12	5.805	2	0.4	...	...	0.64 "
1847	38.6	+1.8	53.2	7.8	50.4	14	3.155	3	Inapp	...	...	0.36 "
1848	34.5	—2.3	49.3	16.5	32.8	9	2.020	3	1.4	N 81° W	1.81	4.81 miles.
1849	42.6	+5.8	56.7	28.4	28.3	10	2.815	2	1.0	N 40° W	1.55	4.78 "
1850	38.8	+2.0	62.3	18.1	44.2	7	2.955	1	Inapp	N 42° W	1.43	5.27 "
1851	32.9	—3.9	50.1	16.5	33.6	5	3.885	6	6.7	N 50° W	1.25	4.70 "
1852	36.0	—0.8	50.4	18.7	31.7	7	1.775	3	2.0	N 59° W	1.53	6.50 "
1853	38.7	+1.9	54.1	14.4	39.7	15	2.425	6	2.7	N 1° E	0.56	5.52 "
1854	36.8	0.0	54.9	15.1	39.8	13	1.115	4	1.3	S 88° W	3.72	7.58 "
1855	38.6	+1.8	54.1	18.7	35.4	8	4.590	6	3.0	N 66° W	3.18	10.81 "
1856	37.4	+0.6	56.4	22.8	33.6	10	1.375	9	9.5	S 85° W	2.95	8.75 "
M	36.80	...	54.71	15.58	39.12	9.2	2.923	4.9	3.0			6.52 miles.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—OCTOBER, 1856.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL. D.

Latitude—45 deg. 32 min. North. Longitude—73 deg, 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32° Fahr.			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Mean direction of Wind.	Velocity in miles per hour.			Snow in Inches.	Rain in Inches.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.		6 A.M.	2 P.M.	10 P.M.			6 A.M.	2 P.M.	10 P.M.
1	29.351	29.356	29.454	48.6	57.2	46.0	.348	.447	.273	.96	.93	.82	w s w	w s w	w s w	w 23 s	9.06	5.71	5.81	...	2.698	Rain.	Cir. Str. 8.	Cir. Str. 8.
2	.508	.548	.704	43.6	49.8	47.0	263	270	291	80	74	86	s w	s w by s	w s w	w 45 s	16.40	12.70	6.71	...	Inp	Cir. Str. 10.	Cir. Str. 8.	Do. 8.
3	.756	.790	.904	43.6	59.6	40.7	272	358	246	91	70	91	w by s	w n w	nwbn	w 30 s	0.62	5.56	3.01	...	...	Clear.	Cir.Cm. Str. 4.	Clear.
4	.980	.992	30.093	36.3	64.0	43.0	230	321	252	96	54	85	w n w	w n w	s by w	w 4 n	0.00	3.08	0.00	...	...	Str. 8.	Cum. 2.	Clear. Aur. Bor.
5	.915	.780	29.793	42.7	68.1	58.5	242	523	462	85	76	93	s e	s by e	w s w	s 11 e	0.36	0.00	0.00	...	0.050	Clear.	Cir. Cum-Str.6	Str. 10.
6	.768	.877	.981	56.2	66.4	47.2	458	464	313	98	72	93	w s w	w s w	n by e	s 33 w	0.80	10.00	4.55	...	0.330	Rain.	Cir. Str. 7.	Cir. Str. 4.
7	30.184	30.141	30.060	48.6	68.4	44.3	312	513	268	89	72	85	w	w	s by e	w 11 n	0.11	1.16	0.90	...	...	Clear.	Cir. Str. 2.	Cir. Str. 4.
8	29.916	29.890	29.904	43.0	67.2	54.0	272	455	351	91	69	83	s by w	s w by s	s w	w 34 s	0.00	4.85	0.00	...	...	Str. 2.	Str. 2.	Clear.
9	.912	.851	.996	52.3	74.9	65.6	349	617	499	87	74	80	w by s	w by s	w by s	w 22 s	8 00	0.00	3.81	...	...	Cir. Str. 2.	Clear.	Do.
10	.930	.814	.839	54.8	80.6	61.0	373	617	441	87	61	81	w s w	w s w	s w	w 40 s	5.05	6.17	4.97	...	...	Cir. Cm. St. 4.	Do.	Do.
11	.713	.907	30.007	53.4	69.9	49.0	361	461	206	87	65	81	w by s	w by s	n by w	w 23 n	9.31	11.11	2.92	...	...	Clear.	Do.	Do.
12	.970	.834	29.756	34.3	63.0	48.9	194	366	302	91	64	86	n e	w s w	w s w	w 22 s	0.45	3.21	4.27	...	...	Do.	Do.	Do. Eclip. of M.
13	.650	.704	.847	42.8	67 9	40.6	272	480	205	94	72	79	w by n	w by s	n w	w 2 n	5.47	4.73	5.72	...	...	Do.	Cir. Str. 8.	Cir. 2.
14	.943	30.022	30.194	31.9	41.0	28.1	167	189	144	84	70	83	n by w	n by w	n w	w 40 n	10.40	6.85	6.55	...	...	Do.	Clear.	Clear.
15	30.254	.203	.121	24.9	47.4	34.6	117	234	189	75	69	86	nw b w	w by s	s w	w 34 s	0.90	9.90	4.31	...	...	Do.	Do.	Do.
16	.044	.025	.089	32.0	54.1	40.2	164	283	196	81	66	75	s w	w b s	w	w 33 s	0.22	3.86	5.08	...	...	Do.	Do.	Do.
17	.056	.051	30.043	32.4	56.6	41.1	175	363	250	87	79	87	s e	s e	s e	e 6° n	0.22	1.02	2.22	...	...	Do.	Do.	Do.
18	29.898	29.850	29.837	40.0	44.6	44.0	233	282	283	87	91	92	e n e	ne by e	ne b n	e 34 n	5.70	8.82	9.33	...	0.466	Cir. Str. 10	Cir. Str. 10.	Cir. Str. 10.
19	.854	.900	.999	44.3	51.3	42.8	283	337	272	92	87	90	w n w	w by s	w s w	w 12 s	2.20	6.22	7.70	...	...	Do. 4.	Do. 6.	Clear.
20	30.046	30.024	30.043	40.7	50.1	38.2	245	326	226	92	87	91	sw by w	w by s	s w	w 33 s	0.02	2.01	0.12	...	...	Fog.	Fog.	Dense Fog.
21	29.961	29.910	29.901	41.0	56 4	50.4	250	385	349	87	84	92	s w	w	n w	w 4 s	1.70	2.07	0 00	...	Inp	Fog.	Fog.	Rain.
22	.736	.654	.657	43.0	44.9	42.3	274	232	263	93	64	90	n e	ne by n	sw b w	n 34 e	11.08	5.95	2.23	...	0.533	Rain.	Cir. Str. 10.	Cir. Str. 10.
23	.654	.714	.870	38.8	42.7	30.1	207	243	145	84	83	79	n w	n w	n wbw	n 40 w	5.00	17.30	9.30	...	...	Clear.	Clear.	Clr. Aur. Bor.
24	.987	.953	30.105	23.6	43.2	29.6	106	184	152	73	63	85	n w	n by e	s w	n 23 w	7.71	8.17	3.22	...	...	Do.	Do.	Do.
25	30.052	30.014	29.945	24.5	47.9	32.3	115	252	170	76	74	84	s w	s w	s s w	w 35 s	0.10	0.98	1.31	...	...	Do.	Do.	Do.
26	29.913	29.857	.902	36.8	53.9	38.0	210	255	190	90	61	78	n w	w	w s w	w 12 s	0.00	0.41	2 03	...	...	Do.	Cir.Cum.Str.4	Do.
27	.843	.549	.807	28.9	45.0	42.0	170	272	250	91	86	87	s s w	s	e by s	s 12 e	1.27	1.62	0.89	...	0.153	Cir. Str. 4.	Cir. Str. 10.	Cir. Str. 10.
28	.464	.327	.310	41.6	50.6	42.5	235	246	232	85	65	82	w by s	w	w	w 5° s	0.82	6.83	11.21	...	0.500	Do. 6.	Do. 9.	Do. 2.
29	.481	.559	.604	35.3	43.6	36.3	155	199	192	70	68	83	w n w	nw b w	s by w	w 33 n	28.01	14.63	7.01	...	...	Do. 10.	Clear.	Do. 10.
30	.336	.338	.394	40.2	41.5	37.4	227	254	199	85	92	83	s s w	w n w	w n w	w 23 n	5.76	5.62	7.71	...	0.490	Rain.	Do.	Clear.
31	.407	.307	.441	28.4	39.8	29.8	144	184	152	83	73	85	w n w	w n w	w n w	w 23 n	7.90	9.22	12.75		...	Clear.	Cir. Str. 4.	Do.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—NOVEMBER, 1856.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Velocity in miles per hour.			Mean direction of Wind.	Rain in Inches.	Snow in Inches.	WEATHER, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A. M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.				6 A. M.	2 P. M.	10 P. M.
1	29.414	29.233	29.292	33.6	34.0	42.2	.204	.206	.234	.92	.92	.83	w s w	sw b w	w	14.00	10.05	7.00	w °3 n	0.033	Inp	Cir. Str. 8.	Cir. Str. 10.	Cir. Str. 10.
2	.582	.600	.756	40.6	47.6	45.6	.248	.291	.292	.90	.86	.92	w s w	sw by s	swb w	12.75	0.22	0.45	w 4 s	0.120	...	Nimb. 10.	Nimb. 10.	C. Str. 6.
3	.855	.784	.677	43.4	45.0	43.6	.272	.296	.279	.91	.90	.9.	SE by s	E	NE b E	1.00	2.62	9.70	E 33 N	0.216	...	Cir. Str. 10.	Cir. Str. 10.	Cir. Str. 10.
4	.482	.114	.057	42.5	56.1	54.4	.284	.408	.418	.92	.88	.92	E N E	E N E	w	3.80	5.71	4.04	E 33 N	0.090	...	Do. 10.	Do. 10.	Rain.
5	.377	.685	.956	26.5	31.0	24.3	.108	.171	.115	.66	.89	.76	w by N	N N W	N W	25.43	33.37	21.06	w 23 N	0.110	...	Do. 10.	Do. 4.	Clr. Aur. Bor.
6	30.238	.220	30.221	17.1	34.9	26.1	.696	.203	.129	.83	.90	.80	w s w	sw bys	s b w	10.03	6.04	4.51	w 40 s	...	...	Clear.	Do. 8.	Clear.
7	.104	.106	30.126	40.7	49.0	40.7	.210	.290	.210	.79	.80	.81	w b s	w b s	s b E	4.66	6.21	8.10	s 11 w	...	...	Cir. Str. 6.	C. St. 4.	Cir. Str. 10.
8	29.886	29.670	29.970	46.0	62.0	37.2	.282	.421	.218	.86	.75	.91	s by w	s	w	11.06	20.11	30.50	w 33 N	0.360	...	Do. 4.	Cul. Str. 9.	Clear.
9	30.050	30.022	30.008	25.6	32.2	24.0	.123	.153	.121	.81	.76	.90	S E	w	Nw b w	8.72	1.37	8.42	w 33 N	...	...	Do. 4.	Do. 9.	Do.
10	.127	.227	.104	16.7	31.1	20.0	.084	.141	.089	.73	.70	.68	NE by N	NWbW	s s w	1.73	2.37	0.40	w 40 N	...	...	Clear.	Clear.	Do.
11	.078	30.035	.009	17.1	53.7	26.9	.184	.153	.129	.73	.74	.80	N W	S E	E N E	0.80	1.07	0.00	E 23 N	...	...	Do.	Do.	Cir. Str. 10.
12	29.967	29.948	29.950	27.6	34.5	31.3	.119	.186	.168	.71	.83	.86	E N E	w s w	w by N	—	—	0.15	w 33 s	...	...	Cir. Str. 6.	C. Str. 9.	Do. 2.
13	.990	.943	30.004	28.9	43 5	30.1	.144	.194	.160	.83	.74	.86	N E	s w b w	s s E	0.21	2.07	—	w 23 N	...	...	Cir. Str. 2.	Do. 6.	Do. 10.
14	.996	29.982	29.940	26.5	31.6	22.9	.147	.152	.115	.90	.78	.82	NW b w	E N E	E N E	4.80	6.23	6.60	E 23 N	...	...	Cir. Str. 10.	Str. 4.	Light Cum. 1.
15	.889	.710	.664	24.0	32.3	21.0	.086	.187	.116	.82	.81	.84	E N E	w N w	w by N	0.33	6.05	5.97	w 15 N	...	...	Clear.	Clear.	Clear.
16	.516	.465	.431	23.1	44.3	31.5	.136	.251	191	.90	.80	.90	w N w	s by E	NE b N	0.16	0.80	1.78	s 23 w	...	0.40	C. Str. 10.	C. Str. 6.	Cir. Str. 10.
17	.447	.492	.591	20.0	26.7	22.5	.107	.146	.120	.82	.81	.82	s w	w N w	w N w	6.15	4.43	6.96	w 23 N	...	Inp	Cir. Str. 2.	Do. 10.	Do. 10.
18	.638	29.760	.870	23.1	34.1	26.3	.106	.178	.129	.74	.83	.80	w N w	w N w	w N w	13.10	11.93	11.90	w 23 N	...	...	Cul. Str. 4.	Do. 9.	Do. 10.
19	.917	.904	.099	29.1	31.8	21.1	.152	.260	.117	.85	.88	.80	w N w	w N w	w	8.09	5.21	0.60	w 12 N	...	...	Str. 1.	Clear.	Clr. Zod. Lgt.
20	.156	.171	.176	20.0	27.0	17.7	.078	.137	.088	.60	.82	.73	w	s w	s w	0.46	0.47	2.80	w 23 s	...	...	Str. 10.	C. Str. 4.	Do. Aur. Bor.
21	.157	.052	.872	20.1	25.0	21.0	.078	.133	.108	.70	.79	.77	s s w	E N E	E N E	2.22	1.14	8.75	E 23 N	...	...	Cir. Str. 10.	Do. 10.	Cir. Str. 10.
22	.690	.740	.914	38.5	46 0	39.2	.226	.254	.199	.89	.70	.76	s	w s w	w s w	13.25	7.21	9.67	s 23 w	1.860	...	Rain.	Do. 8.	Do. 6.
23	30.042	.991	.892	33.0	42.1	35.1	.187	.208	.203	.90	.73	.91	s w	N w	s E	3.26	9.81	1.97	w 34 s	...	...	Clear.	Do. 8.	Do. 10.
24	29.744	.796	.951	33.7	39.1	34.1	.195	.229	.264	.90	.85	.94	N E	N E	E by N	5.71	5.52	0.16	E 33 N	...	...	Cir. Str. 6.	Do. 9.	Do. 10.
25	30.105	30.009	.840	35.3	35.9	32.0	.187	.170	.174	.90	.79	.89	E S E	NE byE	NE b E	0.27	4.92	6.10	E 33 N	...	...	Do. 6.	Do. 9.	Snow.
26	29.831	29.385	.673	33.1	39.0	33.0	.187	.214	.199	.90	.84	.91	N E	w N w	N w	10.60	4.03	8.75	w 20 N	3.910	1.30	Rain.	Do. 8.	C. Str. 10.
27	.694	.597	.654	46.8	30.1	33.8	.177	.187	.112	.95	.87	.67	NW b w	sw bys	N w	19.16	0.41	10.45	w 26 N	...	Inp	Cir. Str. 4.	Str. 10.	Clear.
28	.719	.791	29.864	79.1	20.0	23.0	.107	.119	.085	.82	.81	.88	N N w	N w	N by E	10.81	4.22	5.66	w 43 N	...	...	Clear.	Clear.	Do.
29	.672	.462	.484	54.2	12.3	15.7	.090	.071	.091	.91	.88	.87	NE byE	NE byE	w b s	6.00	8.20	7.90	E 33 N	...	3.00	Cir. Str. 10.	Cir. Str. 10	Snow.
30	.659	.714	.987	78.6	13.3	23.5	.677	.108	.083	.79	.72	.78	w by s	w N w	w by N	12.98	5.27	13.30	w 33 N	...	0.30	Clear.	Do. 6.	Cir. Str. 10.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR OCTOBER.

Barometer	Highest the 15th day	30.254
	Lowest the 28th day	29.310
	Monthly Mean	29.833
	Monthly Range	.944
Thermometer	Highest the 10th day	86°6
	Lowest the 25th day	20°6
	Monthly Mean	46°04
	Monthly Range	66°00

Greatest Intensity of the Suns Ray's .... 99°4
Lowest Point of Terrestrial Radiation .... 18°9
Mean of Humidity .... .809
Amount of Evaporation .... 2.17 inches
Rain fell on 10 days, amounting to 5.220 inches; it was raining 50 hours and 5 minutes.
Most prevalent wind, W S W. Least prevalent wind, E by S.
Most windy day, the 29th day; mean miles per hour, 16.55.
Least windy day, the 5th day, mean miles per hour, 0.23
Most windy hour, from 10 to 11, A. M., 29th day; velocity 31.00 miles.
There were 226 hours and 45 minutes calm.
There were 9 cloudless days in the month.
Total amount of miles of wind, 3732.10 miles, which being resolved into the Four Cardina Points, gives N 843 miles, S 371 miles, W 2270.10 miles, and E 248 miles.
Aurora Borealis visible on 5 nights.
Eclipse of the Moon on the 13th day visible.
The electric state of the atmosphere has been marked by moderate intensity.
Ozone was in moderate quantity.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR NOVEMBER.

Barometer	Highest, the 6th day	30.238
	Lowest, the 4th day	29.057
	Monthly Mean	29.820
	Monthly Range	1.171
Thermometer	Highest, the 8th day	62°.1
	Lowest, the 29th day	12°.1
	Monthly Mean	30°.40
	Monthly Range	50°.0

Greatest intensity of the Sun's Rays .... 89°.7
Lowest point of Terrestial Radiation .... 11°.6
Mean of Humidity .... .835
Rain fell on 8 days, amounting to 6.999 inches; it was raining 31 hours.
Snow fell on 7 days, amounting to 5 inches; it was snowing 19 hours 30 minutes.
Most prevalent Wind was WNW—.1064 miles.
Least prevalent Wind was NNE—.1 mile.
Most windy day, the 5th; mean miles per hour, 26.62.
Least windy day, the 12th; mean miles per hour, 0.05.
Most windy hour from 3 to 4 a. m., on the 8th, 36.40 miles.
There were 149 hours calm during the month.
There were 3 days cloudless.
The whole distance traversed by the wind was 4644 miles; resolved into the Four Cardinal Points, gives N 653; S 650; W 2386; E 975 miles.
Aurora Boreais visible on 2 nights.
The Zodiacal Light first seen on the 19th day, and was very bright on the 20th day.
A Rainbow was visible on the morning of the 7th, at 7.30 which was followed by Rain.
Snow Birds first seen on the 26th day.
The electrical state of the Atmosphere has been marked by very moderate intensity.
Ozone was in moderate quantity.

MEAN RESULTS OF METEOROLOGICAL OBSERVATIONS AT HAMILTON, C. W., FOR THE YEAR 1856.

1856.	THERMOMETER.					BAROMETER.			Days.			YEARS.
MONTHS.	Mean at 9 A. M.	Mean at 9 P. M.	Mean of both.	Highest.	Lowest.	Mean height.	Highest.	Lowest.	Rainy.	Slight Showers.	Dry.	Mean Temperature of.
	°	°	°	°								°
January	15.32	16.9	16.11	42	—16	29.639	30.23	29.15	4	7	20	1846...50.215
February	15.00	18.00	17.50	42	—16	.47	.00	28.70	2	7	20	7...48 163
March	24.03	24.55	24.29	45	—10	.558	.00	.96	4	7	20	8...49.295
April	40.86	44.96	44.41	78	21	.615	.00	29.14	4	7	19	9...48.105
May	65.1	53.22	34.16	90	28	.628	29 95	.22	7	5	19	50...48.732
June	67.5	54.4	65.95	94	46	.6175	.87	.35	4	7	19	51...48.756
July	75.742	74.806	75.274	98	52	.680	.91	.37	0	5	20	2...48.248
August	69.1	67.9	68.5	91	48	.612	29.93	.25	2	7	22	3...49.474
September	60.833	60.4	60.616	86	41	.656	30.00	.20	5	7	18	4...49.013
October	47.7	48 9	48.3	79	28	.7292	.14	.25	1	4	26	5...47.316
November	39.9	39.7	39.8	66	26	.632	29.97	.10	5	8	17	——
December	25.1	24.4	24.75	45	—10	.645	30.35	28.63	5	8	18	Mn. 43.73
Mean Temperature of year			44.888			29.6242			43	79	244	

REGISTER, THERMOMETER, BAROMETER, &c.; HAMILTON, 1856.

DATE.	THERMOM. 9 A.M.	THERMOM. 9 P.M.	BAROM. 9 A.M.	BAROM. 9 P.M.	WEATHER.
	°	°			
December 1	31	27	29.80	29.70	Partly cloudy, some snow A. M.
2	32	32	.63	.25	Cloudy, snowing heavily at night, stormy.
3	36	28	28.68	.02	Partly cloudy, snowing A. M., sleighing.
4	29	30	29.50	.70	Do. do.
5	30	23	.75	.83	Fair and clear.
6	23	22	.80	.81	Do. do.
7	27	24	.80	.76	Partly cloudy.
8	27	29	.81	.90	Do. do., a little snow in the morning.
9	28	25	30.00	30.09	Fair and clear.
10	28	28	29.96	29.70	Do. do.
11	38	40	.20	.20	Rain, sleighing gone.
12	33	34	.45	.62	Partly cloudy.
13	34	34	.85	.60	Do. do., some snow at night.
14	36	26	28.63	28.90	Rainy A. M., snowing P. M., stormy.
15	22	23	29.52	29.70	Partly cloudy, sleighing.
16	21	21	.70	.68	Do. do.
17	15	10	30.60	30.13	Do. do.
18	—2	6	.35	.33	Do. do. a little snow P. M.
19	13	28	.05	29.55	Mostly cloudy, some rain at night forming ice.
20	42	18	29.25	.55	Cloudy, rainy A. M.
21	17	18	.80	.70	Fair and clear.
22	20	17	.40	.52	Mostly cloudy, snowing A. M.
23	13	13	.72	.80	Partly cloudy.
24	15	12	.65	.50	Do. do.
25	16	23	.45	.53	Do. do.
26	25	30	.63	.72	Do. do.
27	23	25	.82	.75	Cloudy.
28	30	32	.40	.45	Do., drizzling rain forming ice.
29	28	26	.55	.65	Mostly cloudy.
30	25	25	.71	.70	Do. do., a little snow at night.
31	23	27	.85	.90	Fair and clear.
Means	25.1	24.4	29.638	29.652	

Mean Temperature of the Month .... 24.75°
Highest .... 45°
Lowest .... 4°
Average of ten preceding years .... 30.76°

THE CANADIAN JOURNAL.

NEW SERIES.

No. VIII.—MARCH, 1857.

THE PRESIDENT'S ADDRESS.

BY THE HON. CHIEF JUSTICE DRAPER, C. B.

Read before the Canadian Institute, January 10*th*, 1857.

My first duty in assuming the Chair of the Canadian Institute, is to thank you for the honour you have done me in electing me to fill a position which has been previously occupied by men justly distinguished, and with such special claims to the honour. Without assuming a forced humility, or that tone of self-depreciation which is ever akin to vanity, I cannot but recognize my own deficiencies, and wish myself better qualified for the duties I ought to discharge. If I have felt hesitation in undertaking these duties, it is from no want of regard for the Canadian Institute, or of desire for its welfare; still less is it from undervaluing those who have assigned to me so conspicuous a place in a body associated together for objects at once so honorable, and so indispensable to the highest interests of this Province. But in accepting the office of President I comfort myself with the assurance that I am surrounded, in the Council, by those selected by you, and well qualified to relieve me of the grave responsibilities which the high aims of this Institute would otherwise impose on me; while I can only assure you that I yield to no member of this Society in earnest zeal for the promotion of its best interests, or in the high estimate of what it is capable of accomplishing for Canada.

The Report of the Council for the year 1856, of the proceedings of the Institute, affords much reason for congratulation. The additions to the number of its members show the increasing sense of the value of the Institute; and this conclusion is strengthened by the observation in the report, that these additions are such as give it "a Provincial rather than a local character," and entitle us to hope for a far more widely extended co-operation than we at first might have reasonably expected. In no respect, perhaps, can that co-operation be more usefully afforded than in communications on the various branches of literature, science, and art, which, read at the meetings of the Institute, may, whenever their novelty or importance justifies it, form part of the published records of our proceedings, in the Canadian Journal. Observation and experience are the sources for enlarging the extent of all our knowledge. The communication of individual observation and experience not only adds to the general mass of what is known, but it furnishes help to the attainment of further knowledge. Every phenomenon, whether the result of physical experiment, or of that class which occur independently of human agency, when properly observed and noted, promotes the knowledge of causes, and aids in the deduction of general laws. I cannot doubt that, among the members of the Institute, there are many capable of responding to the invitation of the Council in this respect, and where the capacity exists I feel less doubt that there will be a readiness shown to co-operate with those who have so strenuously laboured for our advantage, and who devote so much of their time and talents to our service. In no way can a sense of obligation to the Council of the Institute generally, or to the Editing Committee of the Canadian Journal in particular, be more fitly shown than in an endeavour to share in their labours, and to promote the objects to which they are devoted. In so doing we are, in truth, serving ourselves. The influence of science extends alike to agriculture, to commerce, to manufactures, to the administration of justice, to each art of domestic life, and to the prosperity of the Province. The comfort and enjoyment of its inhabitants are dependent on those pursuits. Every advance made in the one is of necessity a corresponding benefit to the other. The time is quickly passing by—in some parts of the Province it has already passed—when all the farmer has to do, after exhausting one portion of his land, is, to leave it to waste, and to clear another. Such a process must very soon bring itself to an end; and those whose whole knowledge of farming has been obtained under such training stand more

in need of guidance than the agriculturists of other countries where more advanced systems of husbandry are in vogue, even though their systems have little pretence to a scientific foundation. But now, when the necessity and value of a different mode of farming are fully felt and acknowledged, science has come to the aid of agriculture; and principles, developed and made manifest by chemical research, have been brought within the husbandman's reach.

The knowledge of what food plants require in order to attain the fullest maturity, and consequently what manures are best fitted to an exhausted soil, or to a soil incapable in its natural composition of affording that nutriment, is one of those benefits which agriculture owes to purely scientific research, and which makes the name of Liebig a household word with every farmer capable of appreciating the advantages so derived.

I am more at home in referring to the acknowledgments which are due for the assistance rendered by physical science and observation in Judicial investigations. The past year has afforded one very remarkable instance of its invaluable service in bringing to justice a criminal, whose slow but surely fatal operations on his victim's life would never have been demonstrated but for the aid of chemical analysis. There was a Nemesis in this. The murderer, who availed himself of the discoveries of chemistry—subtilely, and as he hoped so as to defy detection—to inflict death, was discovered and subjected to his well-deserved fate, through the instrumentality of that very branch of science which he had so grossly abused.

It concerns us all that physical science should unite with jurisprudence in increasing our protection against crime, by affording means, unthought-of before its aid was invoked, for the detection of the guilty. The number of criminals would be greatly reduced if there was an assured certainty that crime would be followed by detection, as well as detection by punishment. As one means of securing this I have observed the practice adopted in England, and I believe also in some other parts of Europe, of taking Photographic likenesses of persons charged with crime, and thus depriving them of the chances of escaping identification, which a change of name or of residence might afford. The A. B. of London criminal notoriety may be arrested in Liverpool and known there only as C. D.; all inquiries respecting him under the *alias* may be wholly unavailing, but the portrait transmitted from the police of the latter to that of the former city, removes the difficulty and puts the avenger of violated aw on the right track.

Still further: Judicial investigation into crime has been assisted by the microscope. It is stated as the result of the most careful and oft repeated examinations, that in every kind of animal the blood contains globules which constitute its colouring matter, differing in size from those of every other, and as a consequence that human blood can be distinguished accurately and certainly when examined through this instrument. By this mode a hiatus in evidence may be filled up, for the want of which a criminal might have escaped; or, on the other hand, circumstances apparently of great suspicion may be satisfactorily rebutted, and an unjustly accused individual may be saved.

I cannot refrain from recalling to you one among many instances of the discoveries of criminals effected through the aid of the microscope, in illustration of what I have said.

A box containing money had been stolen on one of the Railways in Prussia, and, after being emptied of its contents, was filled with sand and replaced on the car. The Police were at fault; the land round most of the stations in the north of Prussia is sandy, and the contents of the box seemed to afford them no clue to the place where the exchange had been made.

Professor Ehrenberg was applied to, and having procured samples of the sand along the line of the Railway, he, with the aid of the microscope, examined them, and also compared them with the sand in the box. The powerful instrument he used enabled him at once to discover the characteristic variations in the mineralogical composition and crystallization of the various specimens of disintegrated rock from the different localities. The station from whence the sand in the box had come was thus ascertained, and the conviction of the thief was the immediate consequence.

To the same professor is also due the application of the microscope for the detection of a singular literary forgery. A pretended palimpsest, purporting to be a history of some of the ancient Kings of Egypt, was submitted to him. It was clearly shown by the microscope that wherever the professedly ancient writing was crossed by that of more modern times, the ink of the old letters lay *upon* instead of *under* those of later date: precisely the reverse of what must have been the case had the palimpsest been genuine. The fraud was immediately and unanswerably exposed.

There are other topics which claim a passing attention. Among these: the proposition to establish a railway communication from Europe to India, intended for the transport of goods as well as of

passengers, is of great interest, and suggests an inquiry as to the channels of former communication between Europe and the East.

According to Robertson, the Phenicians procured the products of India, brought overland, to Rhinocolura, in the Mediterranean, a port, according to the best maps I have had an opportunity of consulting, not far distant from the modern El-Arish, and conveying them by a short transport, thence to Tyre, made the latter city the great emporium of that most profitable commerce. The conquests of Alexander, and the founding of that city which still exists as an enduring monument of his far-sighted sagacity, drew commerce into a new channel, and transferred to Alexandria the trade of which the Phenicians had had the monopoly. Subsequently, a portion of this trade appears to have been carried on up the Euphrates and by land carriage to Palmyra, and thence to the Mediterranean, until the conquest of Palmyra by Aurelian destroyed this commerce. Some portion of the trade was also carried on through the Provinces which extend along the northern frontier of India, either by land carriage into the interior parts of Persia, or by means of rivers through Upper Asia to the Caspian, and thence to the Euxine sea.

It was through such channels of communication that Constantinople obtained its supply of East Indian products. The hostilities that sprang up between the Christians and the Mahommedans, almost, if not entirely, put an end to European intercourse with Alexandria, and with such parts of Syria as had been the marts of Indian commodities. At a later period Venice obtained a great control over this trade, which continued as long as Constantinople remained the capital of the Latin Empire. The restoration of the Imperial family to the throne, however, aided as it was by the Genoese, gave these in turn the advantages which the Venetians had monopolized, and the merchants of Venice were consequently driven to re-establish that commercial intercourse with Alexandria which had been so long interrupted. But the final overthrow of the Greek Empire by Mahomet II., in 1453, deprived the Genoese of their advantages and possessions both at Constantinople and in the Crimea, and again limited the introduction of the commodities of the East into Europe to purchases made in Egypt, or in certain ports in Syria, and this state of things continued until the Portuguese doubled the Cape of Good Hope, towards the close of the 15th century, and thus discovered a new route by ocean navigation to the East. This discovery, and the events consequent upon it, resulted in the almost total extinction of the commerce which Venice had so long enjoyed,

and thenceforward the trade of Europe with India was carried on by sea, though other regions still obtained supplies of Eastern products by land carriage. Of late years the overland route to India by way of Alexandria has been again commonly used by travellers, but it has not been resorted to, at least to any considerable extent, for the conveyance of goods. Now, in addition to this route, two lines for railway communication have been suggested; one by the valley of the Euphrates, which is said to present no physical obstacles that may not readily be surmounted; the other commencing at Acre and passing by Basra, to continue along the southerly side of the Persian Gulph, and then crossing the spur of the Arabian Peninsula to Mascal, a port accessible by a short sea voyage from Bombay. This is represented as being much more direct than either of the other routes. Whether any of them will be found practicable, in a financial and commercial point of view, or in the existing state of things, and considering the character of the people through whose countries the transit is proposed, has yet to be ascertained and determined. Mahommedan antipathies to nations professing Christianity, at least to the Western powers of Europe, have doubtless greatly diminished, and when the "Infidel Soldan" disdains not to wear as a badge of honor, the emblem of the Christian Knight slaughtering the dragon, any enterprise which has no greater obstacles to contend against than religious prejudices, or the antipathies of an uncivilized against a civilized people, and which is backed by the prospect of bringing wealth in its train, need not be despaired of.

Another subject, however, more immediately interesting to us as inhabitants of the Western hemisphere, as well as subjects of the British Empire, claims attention. I allude to the projected Atlantic telegraph. Wonderful as is the application of voltaic electricity to land communication, its capability of adaptation to transmit submarine messages, which is no longer a mere matter of theory, is calculated still more to excite our admiration The nautical and engineering difficulties attending this mode of telegraphic communication have been proved to be surmountable, and the experience gained in establishing shorter lines has led to the determination to undertake this. It is gratifying to observe the unity of thought and action in reference to this great work that prevails on both sides of the Atlantic. A survey was made last summer in a steamer belonging to the United States, and soundings at intervals of about thirty miles were taken, from which it was ascertained that the greatest depth was rather less than $2\frac{2}{3}$ miles. Lieutenant Maury, the su-

perintendent of the observatory at Washington, who deservedly occupies a high place among scientific men, in reporting on this survey, expresses no doubt of the ultimate success of the undertaking. "There is at the bottom of this sea between Cape Race in New-"foundland and Cape Clear in Ireland, a remarkable steppe, which "is already known as the telegraphic plateau," and extends for some 1300 miles in water so deep as to be beneath the effect of any tempest which may agitate the surface, for it has been ascertained "that the currents do not reach down to the bottom of the deep "sea, and that there are no abrading agents there, save alone the "gnawing tooth of time."

The principal difficulty anticipated was the size of the cable supposed to be necessary, not to resist the action of the sea, but to transmit messages at a speed sufficient to ensure commercial success. On this subject a paper was read in August last before the British Association for the advancement of Science, by Mr. E. O. W. Whitehouse, in which he discussed the question whether the law of the squares was applicable or not to the transmission of signals in submarine circuits; and as the result of experiments on the limit to the rapidity and distinctness of utterance attainable—his experiments reaching over wires to the length of 1020 miles—he states his conviction that "nature knows no such application of that law," and that we may shortly expect to see a cable not much exceeding in weight a ton per mile, containing three, four, or five conductors, connecting Europe with America at an expense of less than one-fourth of such a one as would be necessary if the law of the squares were held to be good in its application to submarine currents, and if the deductions as to the necessary size of that wire, based upon that law, could be proved valid. Although his positions were combated, yet the result of his views as to the necessary size of the wire seems to have been adopted, for in an extract from Lt. Maury's report it is said: "It may now be considered as a settled "principle in submarine telegraphy, that the true character of a "cable for the deep sea is not that of an iron rope as large as a "man's arm, but a single copper wire, or a fascicle of wires coated "with gutta percha, pliant and supple, and not larger than a lady's "finger," or, at any rate, than an alderman's thumb!

I have seen it stated that the manufacture of this cable is already commenced, and you are all well aware of the support to the financial part of the undertaking, promised by the British Government. It is difficult to estimate the importance of its success to the North

American Provinces, whether as an element of commercial progress and improvement, or as a means of drawing more closely the ties which unite us to the Mother Country; and, while increasing the advantages we derive from that connection, enhancing the value of these colonies to the empire.

I have met with no account of any very recent proceedings towards the establishment of the interoceanic communication between the Atlantic and the Pacific. The last expedition organized to survey the Isthmus of Darien, was in 1854, when the Governments of England, France, the United States, and Granada, assisted in the object of the expedition. The result of that survey shewed that the harbours of Caledonia and Darien, were in every way adapted as the termini of the suggested Canal. It was further ascertained that a range of mountains varying from 900 to 1600 feet in height form the water-parting of the country, at a distance of only five miles from the Atlantic; the distance between the tidal waters on the opposite coast being under thirty miles; but such is the character of this mountain range, that no canal could be there constructed without tunnelling, though a railway might be constructed between ports, not more than thirty-six miles apart, the summit level to be crossed not exceeding nine hundred feet above the sea. Other lines, having the same object, have been suggested and discussed, but the present unsettled political condition of the territories through or near to which any such communication could be established, seems to postpone indefinitely any practical attempt to realize the design.

In passing from this subject it will not be altogether inappropriate to refer to a matter which has been recently discussed, and on which new light has been thrown by Captain Becher, R.N. I allude to the question where Columbus made his first landing on this side the Atlantic. Navarette names Turks Island as the one which the natives called Guanabani, and on which the discoverer conferred the name of San Salvador. Washington Irving on the other hand decides in favour of Cat Island, situated fully 300 miles distant from Turks Island, and which, on every map that I have seen, is marked as the San Salvador of Columbus. Meenoz, who was the Spanish Cosmographer-in-chief for the department of the Indies, in a history of America, of which he lived to publish only the first volume, points out Watling's Island about fifty miles easterly of Cat Island, as the first landfall, and this view Captain Becher supports and confirms.

Turning to matters of closer local interest I should make a more extended reference to the Geological Map of Canada, prepared by Sir William Logan, but for the circumstance that during the past year it was produced before this Institute, when Sir William favored the members present with some instructive and highly gratifying observations upon it and upon the geological structure of the Province. We then expressed what I am sure we continue to feel, our full appreciation of the valuable services he has rendered in conducting the Survey still in progress, as well as our pleasure to find that his high merit has been recognized and fitly acknowledged, as well by our Sovereign and the French Emperor, as by some of those Societies in England whose members are peculiarly well qualified to judge of the skill and value of his operations.

There is one more subject of at least equal interest, and of no less importance than any on which I have touched, to which I entreat your brief attention. I allude to education, which may be viewed both in reference to the objects of the Canadian Institute, and also in its more extended relation to the advancement and well-being of the Province. As to the former, the observations recently made by Professor Daubeny, so thoroughly, and in such appropriate language, convey what I wish to say, that I gladly avail myself of them. "It begins, indeed, to be generally felt, that amongst the "faculties of mind, upon the development of which in youth, success "in after-life mainly depends: there are some which are best im-"proved through the cultivation of the physical sciences, and that "the rudiments of those sciences are most easily acquired at an "early period of life. That power of minute observation, those "habits of method and arrangement, that aptitude for patient and "laborious enquiry, that tact and sagacity in deducing inferences "from evidence short of demonstration, which the natural sciences "more particularly promote, are the fruits of early education, and "acquired with difficulty at a later period. It is during childhood "also, that the memory is most fresh and retentive, and that the "nomenclature of the sciences, which from its crabbedness and tech-"nicality often repels us at a more advanced age, is acquired almost "without an effort."

It is gratifying to us to know that, so far as is compatible with a system of Common School teaching, elementary instruction in the physical sciences is receiving proper attention; and we may point with pride and pleasure to the conspicuous attainments and ability of many of those who, as Professors in the various branches of lit-

erature and science are employed in University education in this Province. We need not go beyond our own ranks to find several who are justly esteemed as authorities in the departments to which their attention is devoted. But in the schools in which preparation is made for a course of University study, it appears to me there is room for improvement in this particular, and I am sure you will concur with me in expressing a hope, that whatever may be found wanting in this important practical department of education may be speedily supplied.

The other branch of the question is of still more serious consequence. We yet, happily, have the opportunity of endeavouring to anticipate and to prevent evils which older communities are striving to mitigate and to cure. The increase of offences committed by the young, forces itself on the attention of Statesmen as well as of Philanthropists. Lord Stanley, not very long ago remarked, in reference to it: "The only means for diminishing crime consists in the detec-"tion and training of criminal children to habits of honest industry:" a sad but pregnant admission, not only of the absence of right education, but of a training in the paths of vice and crime. Our young country has not yet sunk to that stage of demoralization; we may yet, I trust, look with hope and confidence to the prevention of guilt, by training children before they have become initiated in vicious pursuits; and this is the object attainable, as appears to me, through our Common School system. If it requires any change—any new powers to make it thoroughly efficient in that respect, such change should not be delayed, such powers should not, and I believe, could not be long withheld! No man who seriously reflects on the subject will pay grudgingly the amount he may be taxed to render our Schools accessible to those whose parents or guardians are unable or even unwilling to pay for their education. Every farthing thus expended, will save pounds of the cost attending the detection and punishment of crime. But many will think the taxation neither wise nor just if they see free schools with a comparatively slender attendance, while the streets are filled with idle and vagrant children, ignorant, uneducated, if not already vicious, in danger of falling before the first temptation. It is the office of the Legislature to consider and determine what amount of interference with the rights of parents who neglect this duty to their children should be sanctioned—to what extent and in what manner a needful compulsion should be brought to bear both upon parents and children. It may not be a problem of easy solution, but, I think, it is one that must

be solved. In alluding to this subject here, I trust I have not overstepped the limits, within which, in this place, I ought to confine my remarks, but it is of such paramount importance that scarcely any effort to attract attention to it can be condemned as either ill-timed or misplaced.

But it is time that I bring these desultory observations to a close. More than thirty-six years have passed since I first knew Western Canada. An eye-witness of most of the leading events that have happened in her history during that period, an actor in some of them—I cannot compare what is, with what was, without feelings of mixed wonder and rejoicing. The wilderness has given place to fields of standing corn; towns have sprung up where the first blows of the settler's axe had not yet awakened the echoes of the forest; the locomotive dashes on with fiery speed where the early pioneer explored his dubious way by the Indian path; the vessel launched on the waters of Lake Michigan finds her moorings in the River Mersey! I might compare the Province as it was then, to the bark canoe floating on the waters of a river—as it is now, to a gallant ship entering upon the billows of the broad ocean. At first:

"Through pleasant banks the quiet stream
Went winding pleasantly;
By fragrant fir groves now it past,
And now thro' alder shores;
Through green and fertile meadows now,
It silently ran by!
The flag flower blossomed on its side,
The willow tresses waved,
The flowing current furrowed round
The water-lily's floating leaf,
The fly of green and gauzy wing
Fell sporting down its course.
And grateful to the voyager
The freshness that it breathed,
And soothing to his ear
It's murmur round the prow!"

* * * * *

"But many a silent spring meanwhile,
And many a rivulet and rill,
Had swollen the growing stream.
And when the southern sun began
To wind the downward way of Heaven,
It ran, a river deep and wide,
A broader and a broader stream.

* * * * *

"The sun goes down, the Crescent moon
Is brightening in the firmament,
And what is yonder roar?
That sinking now, and swelling now,
Still louder, louder grows.
* * * * *
"The moon is bright above,
And the great Ocean opens on their way."

May we not well hope that, under the protection of Divine Providence, the future progress of the Province will be even more prosperous than its past has been. Her children enjoy advantages unsurpassed in the history of any country; a soil whose abundant fertility readily yields to the husbandman the most valuable agricultural products; a climate which, notwithstanding its extremes, brings all those products to full maturity; a system of education, adapted in its elementary portion to the wants of the poorest of the community, and rising to the highest requirements of intellectual culture and scientific attainments; a body of law, devised by the wisdom of past ages, and improved by the experience of successive generations; a constitution, which confers the privilege and imposes the obligation of working out the problem of self-government under the guardianship of the Mighty Empire of which we form part; and above all these: for their guiding star, Christianity, which confers, and be it reverently acknowledged, alone confers the power to satisfy the profoundest longings of the human heart, and to lead all who follow its guidance, to the promised haven of eternal peace.

NOTE ON THE COMPOSITION OF PARALLEL ROTATIONS.

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Poinsot, in his famous *Memoire sur la Rotation des Corps*, has pointed out the fundamental connection between the forms to which a system of Forces acting on a rigid body can be reduced, and those by which the motion of a free rigid body at any instant can be exhibited. It is the object of the present note to trace this analogy in a particular case, which has not, so far as I am aware, yet been noticed.

Any system of Forces acting on a rigid body can be reduced to a

single Resultant Force, acting at some assigned point as origin, and to a single resultant couple; the former of these remaining invariable, both in magnitude and direction, whatever origin be assumed while the latter varies in both respects for different origins, remaining constant, however, for origins situated along the direction of the Resultant Force.

Adopting the usual notation by taking as the type of the Forces the rectangular components X, Y, Z of the force acting at the point (x, y, z), we have as resultants at the origin of co-ordinates the single Force whose rectangular components are $\Sigma(X)$, $\Sigma(Y)$, $\Sigma(Z)$; and the single couple whose momental components round the same axes are

$$L=\Sigma(Zy-Yz),\ M=\Sigma(Xz-Zx),\ N=\Sigma(Yx-Xy).$$

If we now seek the resultants corresponding to an origin whose co-ordinates are (x', y', z'), we find the same Resultant Force, and a new resultant couple (L', M', N'), where

$$\begin{aligned} L' &= L + \Sigma(Y).z' - \Sigma(Z).y' \\ M' &= M + \Sigma(Z).x' - \Sigma(X).z' \\ N' &= N + \Sigma(X).y' - \Sigma(Y).x' \end{aligned}$$

From these equations we have

$$L'.\Sigma(X) + M'.\Sigma(Y) + N'.\Sigma(Z) = L.\Sigma(X) + M.\Sigma(Y) + N.\Sigma(Z)$$

Hence if the resultant couple be resolved into two whose axes are respectively perpendicular and parallel to the direction of the Resultant Force, the latter remains invariable in magnitude whatever origin be adopted; and hence also the resultant couple will be the least possible when the origin is so assumed that the former vanishes, or, in other words, when the axis of the couple is in the direction of the Force.

If we seek an origin which shall make the resultant couple vanish, or which shall cause the system of Forces to be reduced to a single resultant Force, we must have for the determination of this origin (x', y', z'),

$$L' = 0,\quad M' = 0,\quad N' = 0,$$

or

$$\left.\begin{aligned} 0 &= L + \Sigma(Y)z' - \Sigma(Z)y' \\ 0 &= M + \Sigma(Z)x' - \Sigma(X)z' \\ 0 &= N + \Sigma(X)y' - \Sigma(Y)x' \end{aligned}\right\}\ \ldots\ldots\ldots(1)$$

These equations are inconsistent unless a certain condition hold, which is,

$$0 = L.\Sigma(X) + M.\Sigma(Y) + N.\Sigma(Z)\ \ldots\ldots\ldots(2)$$

When this condition is satisfied, (provided $\Sigma(X)$, $\Sigma(Y)$, $\Sigma(Z)$, do not all vanish,) the equations (1) are equivalent to only two independent equations, and represent a straight line, every point of which is an origin such as required.

In the particular case where the system consists of Forces in parallel directions, taking F as the type of one of these at the point (x, y, z), and l, m, n for the direction-cosines of their common direction, we have

$$\Sigma(X) = l\,\Sigma(F);\ \Sigma(Y) = m\,\Sigma(F);\ \Sigma(Z) = n\,\Sigma(F);$$

$$\begin{aligned} L &= n\,\Sigma(Fy) - m\,\Sigma(Fz) \\ M &= l\,\Sigma(Fz) - n\,\Sigma(Fx) \\ N &= m\,\Sigma(Fx) - l\,\Sigma(Fy) \end{aligned}$$

The condition (2) is in this case satisfied, and (provided $\Sigma(F)$ do not vanish) the equations (1) assume the form

$$\frac{x' - \dfrac{\Sigma(Fx)}{\Sigma(F)}}{l} = \frac{y' - \dfrac{\Sigma(Fy)}{\Sigma(F)}}{m} = \frac{z' - \dfrac{\Sigma(Fz)}{\Sigma(F)}}{n}$$

Hence the line of action of the single Resultant passes through the point whose co-ordinates are $\dfrac{\Sigma(Fx)}{\Sigma(F)}$, $\dfrac{\Sigma(Fy)}{\Sigma(F)}$, $\dfrac{\Sigma(Fz)}{\Sigma(F)}$; these are independent of l, m, n, and this point therefore remains the same so long as the forces and their points of application are unaltered, whatever be their direction; for this reason, it is called the *Centre of Parallel Forces.*

In like manner, the motion at any instant of a free rigid body can be reduced to a single rotation about an axis passing through some assigned point as origin, and to a single motion of translation proper to this origin and common to all the points of the body; the former of these remaining invariable both in magnitude and direction, whatever origin be assumed, while the latter varies in both respects for different origins, remaining constant, however, for origins situated along the axis of Rotation.

Adopting the usual notation by taking ω_x, ω_y, ω_z, for the components of the rotation round three rectangular axes, and u, v, w for the components of the velocity of translation along the same axes, we have for the velocities u', v', w', along these axes, of a point (x', y', z')

$$\begin{aligned} u' &= u + \omega_y z' - \omega_z y' \\ v' &= v + \omega_z x' - \omega_x z' \\ w' &= w + \omega_x y' - \omega_y x' \end{aligned}$$

and these give the motion of translation when the point (x', y', z') is assumed for origin. From these equations we have

$$u' \omega_x + v' \omega_y + w' \omega_z = u w_x + v w_y + w \omega_z.$$

Hence, if the velocity of translation be resolved into two, respectively perpendicular to and along the axis of rotation, the latter remains invariable in magnitude whatever origin be adopted; and hence also the velocity of translation will be the least possible when the origin is so assumed that the former vanishes, or, in other words, when the velocity of translation is in the direction of the axis of Rotation.

If we seek an origin which shall make the motion of translation vanish, or which shall make the whole motion reducible to a single rotation, we must have for the determination of this origin (x', y', z'),

$$u' = 0, \; v' = 0, w' = 0,$$

or

$$\left.\begin{array}{l} 0 = u + \omega_y z' - \omega_z y' \\ 0 = v + \omega_z x' - \omega_x z' \\ 0 = w + \omega_x y' - \omega_y x' \end{array}\right\} \ldots\ldots\ldots\ldots\ldots(1)$$

These equations are inconsistent unless a certain condition hold, which is

$$0 = u\,\omega_x + v\,\omega_y + w\,\omega_z \ldots\ldots\ldots\ldots\ldots(2)$$

When this condition is satisfied (provided ω_x, ω_y, ω_z do not all vanish), the equations (1) are equivalent to only two independent equations and represent a straight line, every point of which is an origin such as required.

In the particular case where the motion consists of rotations round parallel axes, taking ω as the type of one of these about an axis through the point (x, y, z), and l, m, n for the direction-cosines of the common direction of their axes, we have

$$\omega_x = l\,\Sigma(\omega)\,; \; \omega_y = m\,\Sigma(\omega)\,; \; \omega_z = n\,\Sigma(\omega).$$

Also the linear velocity along the axis of x generated in the origin of co-ordinates by one of these rotations ω being $n\,\omega\,y - m\,\omega\,z$, we have

$$\begin{array}{l} u = n\,\Sigma(\omega y) - m\,\Sigma(\omega z) \\ v = l\,\Sigma(\omega z) - n\,\Sigma(\omega x) \\ w = m\,\Sigma(\omega x) - l\,\Sigma(\omega y) \end{array}$$

The condition (2) is in this case satisfied, and (provided $\Sigma(\omega)$ do not vanish) the equations (1) assume the form

$$\frac{x' - \dfrac{\Sigma(\omega x)}{\Sigma(\omega)}}{l} = \frac{y' - \dfrac{\Sigma(\omega y)}{\Sigma(\omega)}}{m} = \frac{z' - \dfrac{\Sigma(\omega z)}{\Sigma(\omega)}}{n}$$

Hence the axis of the single resultant rotation passes through the point whose co-ordinates are $\frac{\Sigma(\omega x)}{\Sigma(\omega)}$, $\frac{\Sigma(\omega y)}{\Sigma(\omega)}$, $\frac{\Sigma(\omega z)}{\Sigma(\omega)}$; these are independent of l, m, n, and this point therefore remains the same so long as the magnitudes of the rotations, and the points through which their axes are drawn are unaltered, whatever be the common direction of these axes; by analogy this point might be called the *Centre of Parallel Rotations*.

ON A SMALL CAPILLARY WAVE NOT HITHERTO DESCRIBED.

BY JOHN LANGTON, M. A.,

VICE-CHANCELLOR OF THE UNIVERSITY OF TORONTO.

Read before the Canadian Institute, 17th January, 1857.

It is well known that the shape and velocity of waves, and the different circumstances under which they are propagated, have attracted considerable attention amongst men of science, not only from the importance of the subject as connected with the theory of tides, but also from its practical bearing in relation to the resistance of fluids, and the best form for vessels which are destined to move in them. An elaborate report upon waves was prepared by J. Scott Russell, for the British Association, in 1844, the experiments detailed in which have been the origin of some of the greatest improvements of the present day in ship-building, and have inseparably connected the wave line with the name of Russell. Although this report is principally devoted to the solitary wave of translation, which gave rise to the investigation, it treats at less length of other varieties, and may, I believe, be said to embody all that is known upon the subject from observation. There is nothing, however, amongst the waves there enumerated in any way resembling that which I propose bringing under the notice of the Institute to-night, nor have I elsewhere seen any account of its having been previously observed. Amongst all the different kinds of waves, varying as they do in dimensions from the great tidal wave, which, with an elevation of only a few feet, rests upon a base of hundreds of miles in extent, to the ripple which is raised by a summer's breeze, the wave which I am about to introduce to you is, perhaps, the smallest. It

is, indeed, so minute that it might easily have escaped notice, for under ordinary circumstances it cannot much exceed $\frac{1}{20}$ of an inch in height, and hardly reaches an inch in amplitude. Such an exceedingly minute object may seem scarcely of sufficient interest to form the subject of a paper to be read before the Institute; and being apparently only a disturbance of the capillary film on the surface, which is subject to very different laws and forces from those which govern the motions of the whole mass of a fluid, it is doubtless of much inferior importance to the waves which Russell experimented upon. But as no fact is so trifling that it may not assist in establishing correct views of the operations of nature, and as the Institute has invited communications from its members, giving an account of original observations upon all phenomena, I venture to call attention to some curious particulars which I have noticed respecting this capillary wave, which differs from all others previously described in being a solitary one.

The wave in question may be observed in three different situations. Wherever a large body of water, with a strong current, meets comparatively still and deep water below, it may always be seen, as a sharply defined line, like a hair upon the surface, winding about amongst the numerous eddies which are formed in such situations, ever varying in its outline, and carried along apparently with the general course of the stream, whilst upon the whole it maintains nearly the same position. It is also generally to be found where there exists any impediment to a current, as a dead tree projecting out into a river, or a boom thrown across the stream. In this case the wave may be observed at a distance of from one to three feet above the obstacle, the distance varying with the force of the current. The third case is the reverse of the former one, where a body, propelled through still water, pushes this small wave before it. It occurs much more rarely under these circumstances, and may more easily elude observation, and since my attention has been attracted to it I have often failed to produce it; but it was in this form that I first got any insight into its nature.

Paddling in a canoe in a sheltered bay, with just sufficient air stirring overhead, without raising a ripple on the water, to cause the canoe, when abandoned to itself, to drift broadside on at the rate of perhaps half a mile an hour, I perceived the wave in advance of the canoe, at a distance of about three feet. If the wind died away, the wave was maintained at a greater distance, and upon one occasion I could distinctly trace it so far as from between eight and nine feet

from the canoe, beyond which it became fragmentary, and disappeared. If the speed increased suddenly, the wave disappeared, and the slightest ripple on the surface obliterated it at once. But if the wind freshened very gradually, the wave approached nearer and nearer, becoming more strongly defined and more elevated above the surface, and it could still be seen under the lee of the canoe, and at a distance of eight or nine inches from it, after the breeze had increased so as to make a strong ripple on the water outside. If the speed grew still greater, it became first obscured, and finally destroyed, by waves of an entirely different character,—viz., the ripple caused by the canoe itself,—which it is remarkable did not make their appearance in contact with the canoe, but first broke out on the farther side of the capillary wave.

But my attention was principally attracted to the effect which was produced upon the little particles floating near the surface. The opportunity was a good one for observation, for, being in the vicinity of a marsh, the water was very impure, and a bright sunshine enabled me to see the motes at a considerable distance. Light bodies resting on the water without being wetted, as a feather or thistle down, seemed hardly at all affected, except by a slight motion as the wave passed under them; and larger particles, which reached to a depth of perhaps an eighth of an inch, passed it without any disturbance. But smaller ones, floating close to the surface, were violently agitated as the wave reached them, and though they passed a little beyond it, their apparent motion towards the canoe was retarded and finally stopped, at distances from the wave depending upon their respective sizes, the larger ones penetrating the farthest. The interval between the wave and the canoe became thus soon filled with small objects, very regularly sorted according to their sizes, the larger, however, being proportionally much closer together than the smaller ones. If the wind now freshened the wave approached nearer to the canoe, and all the particles were driven in with it, but the smaller ones were much more affected than the larger. If the wind again slackened the wave receded, leaving the particles where they were, and fresh ones were collected in the vacant space, so that, after a few alterations of speed, the regular assortment according to size was soon interfered with, and a miscellaneous scum was pushed on before the canoe, comprising floating matter of all sizes, up to an eighth of an inch or more in depth; for it must be observed, that although objects of that size passed under the wave without disturbance, and penetrated

a long way beyond it without check, their motion was at last arrested before reaching the canoe.

From these facts I was induced to conclude that a body propelled through the water at a low velocity, and with an even regular motion, pushes before it a wedge-shaped film of water, the under surface of which is not a straight line, but a curve of rapidly increasing curvature; that, at very low velocities, this film remains unbroken to a distance of several feet; and that, with increased speed, the distance to which it extends is diminished, whilst its greatest depth remains nearly uniform. There are two things, however, which this supposition will not account for. It will not account for the wave itself: for the film which I have imagined does not appear to extend so far, and under no circumstances did any of the particles, even the smallest, become stationary, till they had passed the wave by about two inches, that interval being always perfectly free from the scum collected. The other circumstance which is left unexplained is, why the feathers and thistle down resting on the water were not also arrested when they came to the film. I do not attempt to account for the difficulty, I only record the facts as I observed them.

I endeavoured to arrive at some conclusion as to the form and size of the wave, but without much success. Its exceeding minuteness, the inconvenient position of the observer in the canoe at a considerable distance from it, and that distance constantly changing with the varying force of the wind, made any accurate measurements almost impossible. I therefore had recourse to the second form, in which I have mentioned that it occurs, where, from the similarity of the circumstances, one would expect to meet with the same facts, and which in many respects afforded greater facilities for observation.

When the water was high in the river in which I made my observations, a great deal of foam came down from the falls above, and at every projecting tree there was a dense collection of froth, with a clear space intervening between it and the wave. Upon clearing away this froth I could observe its gradual re-formation. It was very curious to watch a small patch of foam sailing down with the current. When it approached very close, and in passing the wave, its velocity seemed momentarily increased, but it was then suddenly arrested, whilst there would shoot out from underneath it bits of sawdust, and other matter that had become entangled in it, which would arrange themselves according to their draught of water in the vacant space between the wave and the log, the foam itself remaining

at a distance of about two inches from the wave. Every moment brought down fresh accessions, which gradually pushed on before them that which had already arrived, till the whole space soon became covered as before; but there was always left between the wave and the froth the narrow strip of clear water already mentioned.

Even here it was not easy to ascertain accurately the shape of the wave, in consequence of its constantly shifting with the undulations and irregularities of the current, but I came to the conclusion that it could rarely be more than $\frac{1}{20}$ of an inch high, and I satisfied myself, from the distortion of objects seen by reflection, that the wave was convex towards the direction of the stream, and concave towards the log, the sensible convexity not extending so much as half an inch beyond the sharply defined cusp, and the concavity not very much more. It became questionable even whether it could be said strictly to be elevated above the surface at all, not only because, if the farther side were convex, it was difficult to conceive how it could regain the level without a corresponding concavity, of which I saw no sign, but also from the consideration of the third form in which the wave may be met with, and which I shall mention presently. I was rather led to conclude that the concave side was depressed below the general level, and that the rise towards the log was very gradual.

I had subsequently an unusually good opportunity of seeing the wave in a very extreme case, where a boom had been stretched across a current running at least six miles an hour. Here it approached sometimes within two inches of the dense mass of rubbish collected on the boom, but always with a perfectly clear space intervening, though much narrower than before. The wave itself was apparently fully a quarter of an inch high, and clearly concave towards the boom and convex beyond; but the question of whether it was the result of an elevation or of a depression of the general surface could not be decided, because the whole mass of water was heaped up against the boom, and the farther slope of the wave was broken into a succession of ripples, very much exceeding the primary wave both in height and amplitude, and differing from it in not being cusped, though otherwise imitating its general shape.

There is one point in which the wave, formed above an impediment in a stream, differs from that seen in advance of a body propelled through still water. At a very low velocity I stated that I had seen it at as great a distance as eight or nine feet from the canoe; but in the gentlest stream I do not think I ever saw it as far as four

feet from the object which causes it. The reason appears to me to be, that it is easier to maintain the wave already formed than to form it. I do not believe that it would ever be originally produced at such a distance from a moving body; but, being already formed at a higher velocity, its existence may be prolonged under circumstances which of themselves would not have given rise to it.

The third situation in which the wave occurs, as an undulating line amongst the eddies, does not at first sight appear to bear much analogy to those previously mentioned, and I had for many years noticed it without any clue to its origin; but by the light obtained from observations made in the other cases, it was easy to perceive that it was identical in all the three. When there was foam on the river, it was all collected on one side of the little ridge, with a clear strip intervening, and the same checking of the motion of floating particles took place. Although there was no solid body obstructing a stream in this case, there was still water opposing itself to a current, or at least a stream flowing in one direction impeding an eddy setting upon it sideways. On approaching such a wave with a canoe, one may at once perceive how differently the two sides are affected. If you come down upon it broadside on with the stream, the approach of the canoe has no effect upon it, although you advance quickly enough to make a strong ripple, and you can even pass over it and it re-appears undisturbed on the other side. But if you approach in the other direction, you cannot get near it at all. If you advance upon it cautiously, you drive it on before you, and if you press it too hard, ripples begin to shew themselves on its further face, and it breaks up and disappears. In such situations, by careful handling, I have driven a wave so far as to detach a portion of it from the rest, and have carried it on before me for ten or fifteen yards, whilst, after a while, a new wave was formed in the original situation. This may further illustrate the remark which I before made, that it is much easier to maintain one of these waves in existence than to form one, for I never succeeded in producing one in calm water with the irregular motion which accompanies the most careful use of the paddle.

In some cases, where the water boils up from below, you find an irregular circular patch surrounded by one of these waves, and approaching from the outside you may drive it before you till the two sides meet, or by coming upon it end on, you may divide it into two. In this latter case, if it be not very large originally, both the patches will go on rapidly contracting, till they finally run up to a point with a little conical jet; and if the wave be well marked and your motion

pretty swift, at the moment of disappearance there is a drop of water projected into the air. In such instances, when the circle has become very small, although the motion is too rapid for any precise observation, it is evident to the eye that the included space is elevated above the mean level, which confirms the remark I made when speaking of the shape of the wave.

I believe I have now mentioned all the facts which I have ascertained respecting this apparently insignificant, but in my view very interesting little object, excepting the very different manner in which it is affected by different disturbing causes. As I stated before, if you approach in one direction you may take a canoe over it, and it emerges on the other side unimpaired; the irregular currents of an eddy have no effect upon it, except to give it an undulating movement, and I have seen it maintaining its place amongst the standing waves of a rapid when they have been several inches high. I have even raised considerable swells by rocking a canoe close to it, and it rides over them without disturbance, but the slightest ripple caused by the wind makes it disappear in a moment; and if spirits of turpentine be dropped on the water a little above it, the whole wave is instantly obliterated, to a distance apparently far beyond that to which the oily film extends.

I regret that I can produce no exact numerical data. I made most of these observations some years ago, in the last days of the fall, and whilst I was making preparations for obtaining more precise results the winter overtook me, and before the opening of the water in the spring other avocations interfered with my plans. The points which it appears desirable to ascertain numerically are, the distances of the wave corresponding to different velocities, and the depths to which the film extends at different intervals, also examined at different velocities. The question also arises, what change, if any, is caused by the depth to which the object generating the wave extends. Whether it be a pier rising from deep water, or a two-inch plank floating on the surface, I think there will be found little or no difference; but one would expect that there must be some limit to the draught of water of an obstacle which would raise a wave, corresponding probably to the greatest depth of the film. I confess that I should like to see the experiment repeated with substances merely resting on the water, without being wetted, for the observations which I made appear to be inexplicable, and I unaccountably omitted to verify them under other circumstances.

As I may probably have no opportunity of continuing my observations myself, I mention these desiderata in case any other member of the Institute should fall in with my little friend and take any interest in the investigation of his history.

REVIEW.

Tales of Mystery, and Poems. By Edgar Allan Poe. London: Vizetelly, 1857.

The writings of Edgar Allan Poe have already been appreciated in various forms, and they possess such an individuality of character, and a power of fascination even in their least attractive aspects, that we may be assured they will again and yet again be subjected to re-issue, criticism, censure, and laudation : as intellectual products, ephemeral in their aspect, and yet such as this age at least will not willingly let die. We have purposely selected for our present notice, the volume named at the head of this article, though it is merely a popular selection of a few of Poe's prose writings, issued in a cheap form along with his poems. At another time we may have larger space at our command, and shall then pass under review the more comprehensive literary memorial of this eccentric and wayward child of genius, recently issued from the American press. The publication we refer to is entitled : " The Works of the late Edgar Allan Poe, with a memoir by Rufus Wilmot Griswold; and notices of his genius, by N. P. Willis, and J. R. Lowell." In this latter work four substantial volumes are devoted to the Essays, Poems, and fugitive pieces, and to notices of the biography and genius of Poe,—a writer of whom, if America may not be proud, it is only because the strange moral obliquity of the man, has steeled the hearts of his countrymen against that pride, akin to love, with which they would otherwise have learned to regard the author and the poet. In some striking respects we feel tempted to designate Edgar Allan Poe the Charles Lamb of America —so marked is that strange whimsical individuality of his, that quaint gravity and affectation of seriousness in dealing with a jest, and that sober and deliberate purpose of laughing in his sleeve at the literary lies he successfully palmed upon the most credulous of publics. And yet, assuredly, no two men were every more dissimilar. When, some eleven years after Charles Lamb had been laid beneath the green turf of Edmonton Churchyard, a few survivors of his old circle of friends,—and among the rest his loving biographer, Sir T. N. Talfourd,—met to lay the remains of Mary Lamb along side those of her brother, his biographer thus records the revived memories which the scene awakened: " so dry is the soil of the quiet Churchyard that the excavated earth left perfect walls of stiff clay, and permitted us just to catch a glimpse of the still untarnished edges of the coffin in which all the mortal part of *one of the most delightful*

persons who ever lived was contained, and on which the remains of her he had loved with love passing the love of woman, were henceforth to rest." How strange the contrast of one whom even we who know him only by his writings cannot help loving, with this author who, like him, expresses such unmistakeable individuality and self-originating characteristics on every page, but only to make us admire with shuddering ; as one might gaze on the cold glittering pinnacles of polar ice-cliffs. The poet Lowell has been called in to aid in setting forth the true attributes of his genius, but he had already stamped his just estimate of him in the pungent terseness of a stanza of his "Fable of Critics :"

> "Here comes Poe with his Raven, like Barnaby Rudge,
> Three-fifths of him genius, and two-fifths sheer fudge ;
> He has written some things far the best of their kind,
> But some how the heart seems squeezed out by the mind!"

Genius Poe unquestionably had ; with eccentricities too, enough to furnish any ordinary half dozen of the irritable race of poets, critics, and editors. But the selfishness of morbid sneering cynicism never took a colder and more repellant aspect ; and we look back upon him with a strange sadness as on one of the gifted contributors to the permanent stock of our sources of literary pleasure, whom yet it is all impossible to love. In the prose of Poe, with its odd matter-of-fact anatomising of mystery, there is a singular artificiality of art that seems too much to betray the wires and pulleys of the puppet-master ; but few as are his poems, it is difficult to believe the heart so well simulated, if no genial pulsation of human affection and sympathy actually throbbed beneath that cynic heart of his. To these, therefore, the rare and brief out-gushings, as it might seem, of the genuine feeling of "man of woman born," we shall devote such brief space as the demands on our pages admit, in this notice of Edgar Allan Poe ; remembering that for him, instead of the hero-worship, which fondly exaggerates the virtues of a favorite author, while "to his faults a little blind," it has been till now his fate to be coarsely anatomised by those who have proved only too willing to expose his frailties, if not to deepen the shadows of his dark life-picture. For this there can beno excuse, for whatever his frailties as a man, no charge can be brought against him of having pandered his genius, or wielded his pen in the cause of vice.

The following brief but touching lyric, is dedicated—we may presume,—to the memory of the same "rare and radiant maiden whom

the angels name Lenore," who constitutes the heroine of his more famous "Raven" lyric. But sweet and gracefully touching as are some of the ideas, and musical as are the lines, the "Raven" of Poe's morbid genius flutters ever towards the close, and he winds up this, as well as nearly every other pæan, with thoughts born of his own brooding misanthrophy which could well be spared.

LENORE.

Ah, broken is the golden bowl! the spirit flown for ever!
Let the bell toll!—a saintly soul floats on the Stygian river;
And Guy de Vere, hast *thou* no tear?—weep now or never more!
See! on yon drear and rigid bier, low lies thy love, Lenore!
Come! let the burial rite be read—the funeral song be sung!—
An anthem for the queenliest dead that ever died so young—
A dirge for her the doubly dead in that she died so young.

"Wretches! ye loved her for her wealth, and hated for her pride,
And when she fell in feeble health, ye blessed her—that she died!
How *shall* the ritual, then, be read?—the requiem how be sung
By you—by yours, the evil eye—by yours, the slanderous tongue
That did to death the innocence that died, and died so young?

Peccavimus! but rave not thus! and let a Sabbath song
Go up to God so solemnly the dead may feel no wrong!
The sweet Lenore hath "gone before," with Hope that flew beside,
Leaving thee wild for the dear child that should have been thy bride—
For her, the fair and *debonnair*, that now so lowly lies,
The life upon her yellow hair, but not within her eyes—
The life still there upon her hair—the death upon her eyes.

"Avaunt! to-night my heart is light. No dirge will I upraise,
But waft the angel on her flight with a pæan of old days!
Let *no* bell toll! lest her sweet soul, amid its hallowed mirth,
Should catch the note, as it doth float up from the damned earth,
To friends above, from fiends below, the indignant ghost is riven—
From hell unto a high estate far up within the heaven—
From grief and groan, to a golden throne, beside the King of Heaven."

The same strangely morbid bent of thought which mars the beauty of the stanzas here is perhaps even more apparent in his piece called "The Bells," suggested we can scarcely doubt by Moore's "Evening Bells," ringing, unconsciously perhaps, in memory's ear. But the American Poet's theme is, in its starting point at least, a thoroughly native one: the mirthful, heart-enlivening music of the sleigh-bells, which give a music to our long winter that repays in part the coyness of the spring's forest-songsters, and cheeringly contrasts with the melancholy pathos of our summer nightingale, the Whip-poor-will. We say nothing of certain

ranal choristers, not unknown as Canadian nightingales! The Sleigh Bell; the Wedding Bell; the Fire Bell; and the Funeral Knell; each in succession has a stanza devoted to it. It is not uncharacteristic, nor without its significance, that the "Sabbath Bell" finds no place in the otherwise comprehensive series. The second and the last of these lyrical peals will suffice to exhibit the poet once more in his real aspect of strange antithesis:

Hear the mellow wedding bells,
Golden bells!
What a world of happiness their harmony fortells!
Through the balmy air of night
How they ring out their delight!
From the molten-golden notes,
And all in tune,
What a liquid ditty floats
To the turtle-dove that listens, while she gloats
On the moon!
Oh, from out the sounding cells,
What a gush of euphony voluminously swells!
How it swells;
How it dwells
On the Future! how it tells
Of the rapture that impels
To the swinging and the ringing
Of the bells, bells, bells,
Of the bells, bells, bells, bells,
Bells, bells, bells--
To the rhyming and the chiming of the bells!

* * * * *

Hear the tolling of the bells!
Iron bells!
What a world of solemn thought their monody compels!
In the silence of the night,
How we shiver with affright
At the melancholy menace of their tone!
For every sound that floats
From the rust within their throats
Is a groan.
And the people—Ah, the people—
They that dwell up in the steeple,
All alone,
And who tolling, tolling, tolling,
In that muffled monotone,
Feel a glory in so rolling
On the human heart a stone—
They are neither man nor woman—
They are neither brute nor human—

They are Ghouls;
And their king it is who tolls;
And he rolls, rolls, rolls,
Rolls
A pæan from the bells!
And his merry bosom swells
With the pæan of the bells!
And he dances, and he yells;
Keeping time, time, time,
In a sort of Runic rhyme,
To the pæan of the bells—
Of the bells:
Keeping time, time, time,
In a sort of Runic rhyme,
To the throbbing of the bells—
Of the bells, bells, bells—
To the sobbing of the bells;
Keeping time, time, time,
As he knells, knells, knells,
In a happy Runic rhyme,
To the rolling of the bells—
Of the bells, bells, bells,—
To the tolling of the bells—
Of the bells, bells, bells, bells—
Bells, bells, bells—
To the moaning and the groaning of the bells.

Reiteration is carried here to the utmost length short of wearisome satiety; yet the curious collocation of words must be felt to embody the full ideal of the pealing bells; and this would be much more apparent could we spare room for the whole piece. The varied power of expression is shown by ringing all the changes of words which each successive bell requires. The merry tinkle of the sleigh-bells; the mellow voluminous chime of the wedding bells; the brazen clang of the alarum bells; and the muffled, throbbing knell of the funeral bells; each and all of these seem reproduced in imaginary peal, which echoes through the fancy as the eye silently passes over the curious patch-work of rhyme and rythm strung together in artistic semblance of the music they describe.

One example more we must find room for, of a quaint conceit, more than once successfully accomplished by this singular poet, and perhaps most curious as illustrating the same odd fancy for grappling with self-imposed difficulties, which furnishes the strange plots of so many of his tales of mystery. The subject and occasion of the poem is common,—if not common-place—enough; being one of the thousand-and-one verse missives of the Festival of Saint

Valentine. Some of the rhymes, here as elsewhere, read strangely to unfamiliar ears, e. g. *Lœda* and *reader*. But such are not without precedent on the American Parnassus. Whittier constantly rhymes such words as *law* and *war*, as in the following couplet:

> "Still shall the glory and the pomp of war
> Along their train the shouting millions draw."

No one, however, can have read Poe's "Raven" without recognising his complete mastery of the varied cadences of alliteration, resonance, and the ample musical compass of English rhymes; though in the following bagatelle he had other accomplishments in view:

> For her this rhyme is penned, whose luminous eyes,
> Brightly expressive as the twins of Lœda,
> Shall find her own sweet name, that nestling lies
> Upon the page, enwrapped from every reader.
> Search narrowly the lines!—they hold a treasure
> Divine—a talisman—an amulet
> That must be worn at *heart*. Search well the measure—
> The words—the syllables! Do not forget
> The trivialest point, or you may lose your labour!
> And yet there is in this no Gordian knot
> Which one might not undo without a sabre,
> If one could merely comprehend the plot.
> Enwritten upon the leaf where now are peering
> Eyes scyntillating soul, there lie *perdus*
> Three eloquent words oft uttered in the hearing
> Of poets, by poets—as the name is a poet's too.
> Its letters, although naturally lying
> Like the knight Pinto—Mendez Ferdinando—
> Still form a synonym for Truth.—Cease trying!
> You will not read the riddle, though you do the best you *can* do.

This the reader perchance pronounces no great poetic feat; but he has not yet solved the poet's riddle. In the days of old George Wither, poets were wont to invent for themselves new shackles, and to write rhomboidal dirges, triangular odes, and lozenge-shaped lyrics or canzonets. The acrostic is an old fashion not yet altogether obsolete; and the ordinary restraints of the sonnet, Spenserian stanza, or the ottava rima, still furnish pleasant "poetic pains," as in elder centuries. But the hardest of such poetic labours are trifles compared with that which Poe has here achieved; as will be seen if the reader undertakes its solution according to the following directions. Read the first letter of the first line in connection with the second letter of the second line, the third of the third line, and so on to the end, and the name of the

fair object of the poet's pains will be revealed; a name which though far from common is not unfamiliar to Canadian ears, nor without its memorial amongst ourselves. After all, however, it is on his "Raven" that Poe's fame as a poet will rest, and its strange odd mingling of morbid and beautiful fancies with the luscious surfeitings of rhyme, will long attract and repel the reluctantly admiring reader with its curiously fascinating charms.

D. W.

SCIENTIFIC AND LITERARY NOTES.

ENGINEERING AND ARCHITECTURE.

INTERESTING EXPERIMENT IN STEAM NAVIGATION.

A trial trip of a steam vessel of an interesting character took place on the river Thames, recently. The Hoyer, a paddle steamer, of nearly 190 tons, and drawing only two feet of water has been constructed to navigate the shallow waters on the west coast of Denmark, between the islands and the mainland. A reference to the map of Denmark will show the peculiar geographical position of this part of the coast. From the river Eider to the Horns reef, a distance of 80 miles, it is bounded by a number of islands, varying in size, and situated from three to ten miles from the shore. They are rich in cattle and grain, and inhabited by a hardy and industrious race, who, from their peculiar position, enjoy but little communication with the mainland; the space between being composed of a long, low flat (partly dry at low water,) and numerous small and intricate channels, difficult and tedious to navigate. The communication hitherto could be made only in small boats, and during bad weather the inhabitants have been unable, for weeks together, to communicate with the coast. The Hoyer (so named after one of the towns) has been constructed to remedy this disadvantage, and in conjunction with the Royal Danish Railway, to place the inhabitants of these hitherto isolated places in daily communication, not only with the coast, but with the whole North of Europe. From her light draught of water, she will pass easily over the flats at tide time, while her size and strength will enable her to navigate the channels, conveying passengers, cattle, and goods with speed and safety. The following are her dimensions:—Length, 120 feet; breath, 18½ feet; depth, 7½ feet; gross tonnage, 190; horse power, 40; with accommodation for 80 passengers and 100 tons of cargo. On her trial trip, with the wind against her, and with so little hold of the water, she averaged 12 miles an hour, with scarcely any perceptible effort or vibration, and fully realised the expectations of her constructors.

She has been built for the Husum and Hoyer Steam Packet Company, composed of Danish and English proprietors, to ply between those places and the islands, in connection with the Royal Danish Railway, which connects the North Sea with the Baltic. This railway, the result of the skill and enterprise of Sir S. M. Peto and his friends, is now in full operation, and has not only opened a short and expeditious route to the Baltic, but has placed at the disposal of our markets an almost inexhaustible supply of cattle and grain. To the port of Tonning, on the Eider, the North Sea terminus of this railway, a place but little known a few years since, two large steamers, belonging to the North of Europe Steam Navigation Company, ply weekly from London and Hull; whilst on the opposite side, at Flensburg, on the Baltic, a fleet of smaller steamers, belonging to the same company, maintain the communication with Copenhagen, Husum, Aarhuus, Stettin, Dantzic, Konisberg, and St. Petersburg.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

(Concluded.)

CHELTENHAM, 6th August, 1856.

"UNEQUAL SENSIBILITY OF THE FORAMEN CENTRALE TO LIGHT OF DIFFERENT COLOURS," BY MR. J. C. MAXWELL.

When observing the spectrum formed by looking at a long vertical slit through a simple prism, I noticed an elongated dark spot running up and down in the blue, and following the motion of the eye as it moved *up and down* the spectrum, but refusing to pass out of the blue into the other colours. It was plain that the spot belonged both to the eye and to the blue part of the spectrum. The result to which I have come is, that the appearance is due to the yellow spot on the retina, commonly called the *Foramen Centrale* of Soemmering. The most convenient method of observing the spot is by presenting to the eye, in not too rapid succession, blue and yellow glasses, or, still better, allowing blue and yellow papers to revolve slowly before the eye. In this way the spot is seen to fade away in time, and to be renewed every time the yellow comes in to relieve the effect of the blue. By using a Nicol's prism along with this apparatus the brushes of Haidinger are well seen in connexion with the spot, and the fact of the brushes being the spot analyzed by polarized light becomes evident. If we look steadily at an object behind a series of bright bars which move in front of it, we shall see a curious bending of the bars as they come up to the place of the yellow spot. The part which comes over the spot seems to start in advance of the rest of the bar, and this would seem to indicate a greater rapidity of sensation at the yellow spot than in the surrounding retina. But I find the experiment difficult, and I hope for better results from more accurate observers.

"ON AN INSTRUMENT TO ILLUSTRATE POINSÔT'S THEORY OF ROTATION," BY MR. J. C. MAXWELL.

In studying the rotation of a solid body according to Poinsôt's method, we have to consider the successive positions of the instantaneous axis of rotation with reference both to directions fixed in space and axes assumed in the moving body. The paths traced out by the pole of this axis on the *invariable plane* and on the *central ellipsoid* form interesting subjects of mathematical investigation. But, when

we attempt to follow with our eye the motion of a rotating body, we find it difficult to determine through what point of the *body* the instantaneous axis passes at any time,—and to determine its path must be still more difficult. I have endeavoured to render visible the path of the instantaneous axis, and to vary the circumstances of motion, by means of a top of the same kind as that used by Mr. Elliott to illustrate precession. The body of the instrument is a hollow cone of wood, rising from a ring, seven inches in diameter and one inch thick. An iron axis eight inches long, screws into the vertex of the cone. The lower extremity has a point of hard steel, which rests in an agate cup, and forms the support of the instrument. An iron nut, three ounces in weight, is made to screw on the axis, and to be fixed at any point; and in the wooden ring are screwed four bolts, of three ounces, working horizontally, and four bolts, of one ounce, working vertically. On the upper part of the axis is placed a disc of card, on which are drawn four concentric rings. Each ring is divided into four quadrants, which are coloured red, yellow, green and blue. The spaces between the rings are white. When the top is in motion, it is easy to see in which quadrant the instantaneous axis is at any moment, and the distance between it and the axis of the instrument; and we observe:—1st. That the instantaneous axis travels in a closed curve, and returns to its original position in the body. 2nd. That by working the vertical bolts, we can make the axis of the instrument the centre of this closed curve. It will then be one of the principal axes of inertia. 3rd, That by working the nut on the axis, we can make the order of colours either red, yellow, green, blue, or the reverse. When the order of colours is in the *some* direction as the rotation, it indicates that the axis of the instrument is that of *greatest* moment of inertia. 4th. That if we screw the two pairs of opposite horizontal bolts to different distances from the axis, the path of the instantaneous pole will no longer be equi-distant from the axis, but will describe an ellipse, whose longer axis is in the direction of the *mean axis* of the instrument. 5th. That, if we now make one of the two horizontal axes less and the other greater than the vertical axis, the instantaneous pole will separate from the axis of the instrument, and the axis will incline more and more till the spinning can no longer go on, on account of the obliquity. It is easy to see that, by attending to the laws of motion, we may produce any of the above effects at pleasure, and illustrate many different propositions by means of the same instrument.

"ON THE BALAKLAVA TEMPEST, AND THE MODE OF INTERPRETING BAROMETRICAL FLUCTUATION," BY MR. T. DOBSON.

In the month of November, 1854, the passage of a storm over the British islands caused a considerable depression of the barometric column, beginning on the 11th of November and ending on the 19th. During four consecutive days of this period of diminished atmospheric pressure, there occurred in the coal mines of Britain, five fatal explosions, at the following places:—on Nov. 13, at Old Park Colliery, Dudley, Worcestershire; Nov. 14, Cramlington Colliery, Northumberland; Nov. 15, Bennet's Colliery, Bolton, Lancashire, and Birchey Coppice Colliery, Dudley; Nov. 16, Rosehall Colliery, Coatbridge, N. B. These facts alone render this storm worthy of special attention, independently of the notoriety which it has acquired from its disastrous effects on the allied fleets and armies in the Crimea. The meteorological circumstances which characterized the Balaklava tempest have been determined with unusual care and skill, from a very great number of observations at stations spread over the whole surface of Europe, by M. Liais, of the Imperial

Observatory at Paris. In all probability, many years will elapse before a great storm on land is subjected to an examination so rigorous and complete as that undertaken by M. Liais in the present instance. This storm may, therefore, be adopted as the most satisfactory test that we are likely to have for some time to come of the correctness of the principles of interpretation which I have already applied to barometric fluctuations, in my report on the relation between explosions in coal mines and revolving storms,—principles which flow directly from the nature of cyclones. The cyclonic interpretation in this case would be—First, that the curves indicate the passage of a cyclonic, of which the centre passed to the Southward of England. This is inferred from the gradual increase of the barometric depression from the Orkneys in the north to Teignmouth in the south, and depends on the fact that the height of the mercurial column decreases continuously from the circumference to the centre of the cyclone. This inference is confirmed by the observation that the wind blew from the eastward at all the stations. Second, that the cyclone was progressing to the eastward. This is derived from observing that, at each station, the wind began at S. E. while the mercury was falling, veered to E. when the mercury was lowest, and then to N. E. as the mercury rose. The charts of M. Liais fully establish the truth of the inferences derived above from the contemporaneous barometric curves in Britain. They prove that the Balaklava tempest was a cyclone, moving to the eastward, along a central track which passed to the southward of Britain. It is known that during their transit from the Gulf of Mexico to the western coasts of Europe, across the comparatively uniform surface of the ocean, cyclones preserve an approximately circular form. The excellent charts of M. Liais, at the same time that they exhibit the progress of the storm day by day, from the shores of Britain across the continent of Europe, to the Caucasian mountains and the borders of the Caspian Sea, show also the remarkable modifications produced in the normal condition of the cyclone by mountains and other irregularities of the surface of the land. Thus, for example, a portion of the cyclone is delayed nearly twenty-four hours in passing the Alps. The consequence of this and similar obstructions is, that what was nearly a circular atmospheric wave while crossing the ocean, takes the form of a much elongated and somewhat distorted ellipse on land, enveloping an elliptical central area of maximum barometric depression, which extends, on one chart, from Dantzic in the Baltic to Varna in the Black Sea. Around this central space the wind still blows continuously in the direction peculiar to the cyclones of the northern hemisphere. In the case, therefore, of the Balaklava tempest, whose nature has been determined with much greater exactness than that of any other tempest on land, we have unequivocal testimony that the principles of cyclonology may be safely applied to interpret the fluctuations of the barometer in Great Britain.

ON ATMOSPHERIC CURRENTS AT LIVERPOOL.

This was supplementary to Mr. Osler's previous reports, and related to the diurnal laws of the wind when referred to sixteen points of the compass, giving the mean results of above 70,000 observations. It appeared that at Liverpool the various winds have their maximum and minimum velocity at definite and generally different hours. Thus the E.N.E. wind has its maximum about 5 p.m., the E. at 9 p,m., the E.S.E. at midnight, the S.E. at 6 a.m., S.S.E. at 10 a.m., S. at noon, and the corresponding minimums at twelve hours distance from these respectively. The N.N.E. and S.S.W. have each two maximums and minimums in the twenty-four hours. Generally the maximum velocity is about double the minimum.

AN IMPROVED STEREOSCOPE, BY M. A. CLAUDET.

This is designed to remedy the illusion of curvature shewn by plane surfaces when examined by the refracting or semilenticular stereoscope. This illusion M. Claudet thinks arises from the fact that straight lines, viewed through a prism or semilens, parallel to the base thereof, are bent with a concavity towards the edge of the prism or lens; and both the pictures in the stereoscope being bent in the same manner, their coalescence produces a surface concave to the spectator. To avoid this defect, only the central part of each lens is employed, and the axes of the eyes are to be pointed in nearly parallel directions. In illustration of this theory, M. Claudet mentioned a beautiful optical experiment. If holding a prism in each hand, their refracting edges being vertical and turned towards each other, the window of a room be looked at, at first, two windows are seen with their vertical lines bent in opposite directions: by inclining gradually the optic axes of the eyes, the two images can be made to coincide, and, in the single resulting window, the latent curvature of the vertical lines ceases and is replaced by a curvature from back to front, producing the illusion of a window concave to the spectator.

THE POLYHEDRON OF FORCES, BY MR. J. T. GRAVES.

"If any number of forces act upon a point and be represented in magistude by the areas of the faces of a polyhedron, their directions being normal to these faces, they will keep the point at rest."

This is an extension of the well known principle of the "Polygon of Forces." It can also be applied to the composition of Couples, and Linear and Rotatory velocities after the manner of Poinsot.

THE LAW OF THE SQUARES—IS IT APPLICABLE OR NOT TO THE TRANSMISSION OF SIGNALS IN SUBMARINE CIRCUITS?"—BY MR. O. W. WHITEHOUSE.

Before proceeding to the consideration of this subject, the author wished to explain, with reference to his paper read on a previous day, that it was for the purpose of determining the force of either intermitting or alternating currents, whose duration was not sufficient to admit of the needle assuming a position of rest, that he proposed the use of the magneto-electrometer—an instrument rendering available the force of magnetic attraction instead of the deflection of the needle—as a means of measuring the amount of current circulating. This force was, he said, until we approach the point of magnetic saturation of the iron, strictly proportioned to the energy of the current under examination. The number of grains thus lifted on the arm of the lever, the author proposes to call the practical "value" of the current for telegraphic purposes. The most striking features of this instrument are—1st. The facility of determining the value of currents which do not admit of being tried by the galvanometer;—2nd. The very great range which this instrument has (viz., from unity up to half a million,) as well as the definiteness and accuracy of the results, even the extremes of the register being strictly comparable with each other;—3rd. Unlike the degrees upon the galvanometer, these grains of force are units of real "value" and of practical utility, as was shown by a telegraphic instrument in circuit being worked perfectly by a current of four grains. Referring to the proceedings of this Section last year, at Glasgow, the author quoted Prof. W. Thomson's paper on this subject, where he stated "that a part of the theory communicated by himself to the Royal Society last May, and published in

the proceedings, shews that a wire of six times the length of the Varna and Balaklava wire, if of the same lateral dimensions, would give thirty-six times the retardation, and thirty-six times the slowness of action. If the distinctness of utterance and rapidity of action practicable with the Varna and Balaklava ... are only such as not to be inconvenient, it would be necessary to have a wire of six times the diameter or better, thirty-six wires of the same dimensions, or a larger number of small wires twisted together, under a gutta-percha covering, to give tolerably convenient action by a submarine cable of six times the length." The author then stated, that circumstances had enabled him to make very recently a long series of experiments upon this point, the results of which he proposed to lay before the Section; adding, that an opportunity still existed for repeating these experiments upon a portion of cable to which he could obtain access, and that he was ready to show them before a committee of this Section in London, if the important nature of the subject should seem to render such a course desirable. Although the subject of submarine telegraphy had many points of the highest importance requiring investigation, and to the consideration of which he had been devoting himself recently, Mr. Whitehouse proposed to confine his remarks on this occasion to the one point indicated in the title, inasmuch as the decision of that one, either favourably or otherwise, would have, on the one hand, the effect of putting a very narrow limit to our progress in telegraphy, or, on the other, of leaving it the most ample scope He drew a distinction between the mere transmission of a current across the Atlantic (the possibility of which he supposed everybody must admit) and the effectual working of a telegraph at a speed sufficient for "commercial success;" and we gathered from his remarks that there were those ready to embark in the undertaking as soon as the possibility of "commercial success" was demonstrated. The author then gave a description of the apparatus employed in his researches, of the manner in which the experiments were conducted, and, lastly, of the results obtained. The wires upon which the experiments were made were copper, of No. 16 gauge, very perfectly insulated with gutta-percha—spun into two cables, containing three wires of equal length (83 miles,) covered with iron wires and coiled in a large tank in full contact with moist earth, but not submerged. The two cables were subsequently jointed together, making a length of 166 miles of cable, containing three wires. In addition to this, in some of the latest experiments, he had also the advantage of another length of cable, giving, with the above, an aggregate of 1,020 miles. The instruments, one of which was exhibited, seemed to be of great delicacy, capable of the utmost nicety of adjustment, and particularly free from sources of error. The records were all made automatically, by electro-chemical decomposition, on chemically prepared paper. The observations of different distances recorded themselves upon the same slip of paper,—thus, 0.83 and 249 miles were imprinted upon one paper, 0.83, 498 miles upon another slip, and 0.249, 498 upon another, and 0.535, 1,020 upon another. Thus, by the juxtaposition of the several simultaneous records on each slip, as well as by the comparison of one slip with another, the author has been enabled to show most convincingly that the law of the squares is not the law which governs the transmission of signals in submarine circuits. Mr. Whitehouse showed next, by reference to published experiments of Faraday's and Wheatstone's (*Philosophical Magazine*, July, 1855,) that the effect of the iron covering with which the cable was surrounded was, electrically speaking, identical with that which would have resulted from submerging the wire, and that the results of the experiments could

not on that point be deemed otherwise than reliable. The author next addressed himself to the objections raised against conclusions drawn from experiments in "Multiple" cables. Faraday had experimented, he said, upon wires laid in close juxtaposition, and with reliable results; but an appeal was made to direct experiment, and the amount of induction from wire to wire was weighed, and proved to be as one to ten thousand, and it was found impossible to vary the amount of retardation by any variation in the arrangement of the wires. Testimony, also, on this point was not wanting. The Director of the Black Sea Telegraph, Lieut. Col. Biddulph, was in England, and present at many of the experiments. He confirmed our author's view, adding, "that there was quite as much induction and embarrassment of instruments in this cable as he had met with in the Black Sea line." The author considers it, therefore, proved "that experiments upon such a cable, fairly and cautiously conducted, may be regarded as real practical tests, and the results obtained as a fair sample of what will ultimately be found to hold good practically in lines laid out *in extenso.* At the head of each column in the annexed table is stated the number of observations upon which the result given was computed,—every observation being rejected on which there could fall a suspicion of carelessness, inaccuracy, or uncertainty as to the precise conditions; and, on the other hand, every one which was retained being carefully measured to the hundredth part of a second. This table is subject to correction, for variation in the state of the battery employed, just as the barometrical observations are subject to correction for temperature. Of this variation as a source of error I am quite aware, but I am not yet in possession of facts enough to supply me with the exact amount of correction required. I prefer, therefore, to let the results stand without correction.

AMOUNT OF RETARDATION OBSERVED AT VARIOUS DISTANCES. VOLTAIC CURRENT TIME STATED IN PARTS OF A SECOND.

Mean of 550 obsrvns.	Mean of 110 obsrvns.	Mean of 1840 obsrvns.	Mean of 1960 obsrvns.	Mean of 120 simultaneous observations.	
83 miles ·08	166 miles ·14	249 miles. ·36	498 miles. ·79	535 miles. ·74	1020 miles. 1·42.

—Now it needs no long examination of this table to find that we have the retardation following an increasing ratio,—that increase being very little beyond the simple arithmetical ratio. I am quite prepared to admit the possibility of an amount of error having crept into these figures, in spite of my precautions; indeed, I have on that account been anxious to multiply observations in order to obtain most trustworthy results. But I cannot admit the possibility of error having accumulated to such an extent as to entirely overlay and conceal the operation of the law of the squares, if in reality that law had any bearing on the results. Taking 83 miles as our unit of distance, we have a series of 1, 2, 3, 6, and 12. Taking 166 miles as our unit we have then a series of 1, 3, and 6. Taking 249 miles, we have still a series of 1, 2 and 4, in very long distances. Yet even under these circumstances, and with these facilities, I cannot find a trace of the operation of that law." The author then examined the evidence of the law of the squares, as shown by the value of a current taken in submarine or subterranean wires at different distances from the

generator thereof, which he showed were strongly corroborative of the previous results. He next examined the question of the size of the conducting wire; and he had the opportunity of testing the application of the law, as enunciated by Prof. Thomson last year. The results, far from confirming the law, are strikingly opposed to it. The fact of trebling the size of the conductor augmented the amount of retardation to nearly double that observed in the single wire. The author, however, looked for the *experimentum crucis* in the limit to the rapidity and distinctness of utterance attainable in the relative distances of 500 and 1,020 miles. 350 and 270 were the actual number of distinct signals recorded in equal times through these two lengths respectively. These figures have no relation to the squares of the distance. "Now, if the law of the squares be held to be good in its application to submarine circuits, and if the deductions as to the necessary size of the wire, based upon that law, can be proved to be valid also, we are driven to the inevitable conclusion that submarine cables of certain length to be successful must be constructed in accordance with these principles. And what does this involve? In the case of the Transatlantic line, whose estimated length will be no less than 2,500 miles, it would necessitate the use, for a single conductor only, of a cable so large and ponderous, as that probably no ship except Mr. Scott Russell's leviathan could carry it,—so unwieldy in the manufacture, that its perfect insulation would be a matter almost of practical impossibility,—and so expensive, from the amount of materials employed, and the very laborious and critical nature of the processes required in making and laying it out, that the thing would be abandoned as being practically and commercially impossible. If, on the other hand, the law of the squares be proved to be inapplicable to the transmission of signals by submarine wires, whether with reference to the amount of retardation observable in them, the rapidity of utterance to be attained, or the size of conductor required for the purpose, then we may shortly expect to see a cable not much exceeding one ton per mile, containing three, four or five conductors, stretched from shore to shore, and uniting us to our Transatlantic brethren, at an expense of less than one-fourth that of the large one above mentioned, able to carry four or five times the number of messages, and therefore yielding about twenty times as much return in proportion to the outlay. And what, I may be asked, is the general conclusion to be drawn as the result of this investigation of the law of the squares applied to submarine circuits? In all honesty, I am bound to answer, that I believe nature knows no such application of that law; and I can only regard it as a fiction of the schools, a forced and violent adaptation of a principle in Physics, good and true under other circumstances, but misapplied here."

In reply to this, Prof. W. Thomson writes to the *Atheneum*, that he believes Mr. Whitehouse's results are reconcileable with his theory, because he is confident that the theory is true, though he is not confident that he sees the true way of reconcilement; and, in the mean time, he believes that a more "matter of fact" proof must be afforded of the possibility of attaining sufficient capacity of communication through a cable 1,000 miles long, than Mr. Whitehouse's experiments supply. Mr. Whitehouse, in answer, says, that this "matter of fact" proof has been given—in short—"we have recently telegraphed at a commercially satisfactory speed through an unbroken subterranean circuit of 2,000 miles." Prof. Thomson, (*Atheneum*, Nov. 1,) now enters into an elaborate discussion, in which he appears to concede the question so far as the practical working of the telegraph is concerned with the "law of squares:" he shews that in results calculated from the

theory, the deviations, from the law of squares, occur to as great an extent as in Mr. Whitehouse's actual experiments; these deviations, depending on the precise nature "of the electrical operations performed at one end of the wire, and of the test of electrical effect afforded by the receiving instrument at the other hand."

ON THE MANUFACTURE OF IRON AND STEEL WITHOUT FUEL, BY MR. W. BESSAMER.

Mr. Bessamer asserted that crude iron contains about 10 per cent. of carbon; that carbon cannot exist at white heat in the presence of oxygen, without uniting therewith and producing combustion, that such combustion would proceed with a rapidity dependent on the amount of surface of carbon exposed; lastly, that the temperature which the metal would acquire would be also dependent on the rapidity with which the oxygen and carbon were made to combine, and consequently that it was only necessary to bring the oxygen and carbon together in such a manner that a vast surface should be exposed to their mutual action in order to produce a temperature hitherto unattainable in our largest furnaces. With a view of testing practically this theory, he had constructed a cylindrical vessel of three feet in eight, somewhat like an ordinary cupola furnace, the interior of which was lined with fire-bricks; and about two inches from the bottom of it inserted five tuyere pipes, the nozzles of which were framed of well burnt fire-clay, the orifice of each tuyere pipe being about three-eighths of an inch in diameter. These were so put into the brick lining (from the outer side) as to admit of their removal and renewal in a few minutes when they were worn out. At one side of the vessel, about half way up from the bottom, there was a hole made for running in the crude metal, and on the opposite side there was a tap-hole stopped with loam, by means of which the iron was run out at the end of the process. The vessel should be placed so near to the discharge-hole of the blast furnace as to allow the iron to flow along a gutter into it. A small blast cylinder would be required, capable of compressing air to about 8 lb. or 10 lb. to the square inch. A communication having been made between it and the tuyeres before named, the converting vessel would be in a condition to commence work. It would, however, on the occasion of its being first used after re-lining with fire-bricks, be necessary to make a fire in the interior with a few baskets of coke, so as to dry the brickwork and heat up the vessel for the first operation, after which the fire would have to be all carefully raked out at the tapping-hole, which would again be made good with loam. The vessel would then be in readiness to commence work, and might be so continued without any use of fuel, until the brick lining in the course of time became worn away and a new lining was required. The tuyeres are situated nearly close to the bottom of the vessel; the fluid metal will therefore rise some eighteen inches or two feet above them. It is necessary, in order to prevent the metal from entering the tuyere-holes, to turn on the blast before allowing the fluid crude iron to run into the vessel from the blast furnace. This having been done, and the fluid iron run in, a rapid boiling up of the metal will be heard going on within the vessel, the metal being tossed violently about, and dashed from side to side, shaking the vessel by the force with which it moves from the throat of the converting vessel. Flame will then immediately issue, accompanied by a few bright sparks. This state of things will continue for about 15 or 20 minutes, during which time the oxygen in the atmospheric air combines with the carbon contained in the iron, producing carbonic acid gas, and at the same time evolving a powerful heat. Now, as this heat is generated in the interior of, and is diffused in innumerable fiery bubbles through the whole fluid mass, the metal absorbs the greater part of it, and its temperature becomes immensely increased;

and by the expiration of the 15 or 20 minutes before named, that part of the carbon which appears mechanically mixed and diffused through the crude iron has been entirely consumed. The temperature, however, is so high that the chemically-combined carbon now begins to separate from the metal, as is at once indicated by an immense increase in the volume of flame rushing out of the throat of the vessel. The metal in the vessel now rises several inches above its natural level and a light frothy slag makes its appearance, and is thrown out in large foam-like masses. This violent eruption of cinder generally lasts five or six minutes, when all further appearance of it ceases—a steady and powerful flame replacing the shower of sparks and cinder which always accompanies the boil. The rapid union of carbon and oxygen which thus takes place adds still further to the temperature of the metal, while the diminished quantity of carbon present allows a portion of the oxygen to combine with the iron, which undergoes combustion, and is converted into an oxide. At the excessive temperature that the metal has now acquired, the oxide, as soon as formed, undergoes fusion, and forms a powerful solvent of those earthy bases that are associated with the iron. The violent ebullition which is going on mixes most intimately with scoriæ and metal, every part of which is thus brought into contact with the fluid, which will thus wash and cleanse the metal most thoroughly from the silica and other earthy bases which are combined with the crude iron, while the sulphur and other volatile matters which cling so tenaciously to iron at ordinary temperatures are drawn off, the sulphur combining with the oxygen, and forming sulphurous acid gas. The loss in weight of crude iron during its conversion into an ingot of malleable iron, was found, on a mean of four experiments, to be 12½ per cent., to which will have to be added the loss of metal in the finishing rolls. This will make the entire loss probably not less than 18 per cent., instead of about 28 per cent., which is the loss on the present system. A large portion of this metal is, however, recoverable, by treating with carbonaceous gases the rich oxides thrown out of the furnace during the boil. These slags are found to contain innumerable small grains of metallic iron, which are mechanically held in suspension in the slags, and may be easily recovered, by opening the tap-hole of the converting vessel, and allowing the fluid malleable iron to flow into the iron ingot moulds placed there to receive it. The masses of iron thus formed will be perfectly free from any admixture of cinder, oxide, or other extraneous matters, and will be far more pure and in a sounder state of manufacture than a pile formed of ordinary puddle bars. And thus it will be seen that by a single process, requiring no manipulation or particular skill, and with only one workman, from three to five tons of crude iron passes into the condition of several piles of malleable iron in from thirty to thirty-five minutes, with the expenditure of about one-third part the blast now used in a fiery furnace with an equal charge of iron, and with the consumption of no other fuel than is contained in the crude iron. To persons conversant with the manufacture of iron (said Mr. Bessamer), it will be at once apparent that the ingots of malleable metal which I have described will have no hard or steely parts, such as are found in puddled iron, requiring a great amount of rolling to blend them with the general mass; nor will such ingots require an excess of rolling to expel cinder from the interior of the mass, since none can exist in the ingot, which is pure and perfectly homogeneous throughout, and hence requires only as much rolling as is necessary for the developement of fibre; it therefore follows that, instead of forming a merchant bar or rail by the union of a number of separate pieces welded together, it

will be far more simple and less expensive to make several bars or rails from a single ingot. Doubtless this would have been done long ago, had not the whole process been limited by the size of the ball which the puddler could make. I wish to call the attention of the Meeting to some of the peculiarities which distinguish cast steel from all other forms of iron—namely, the perfect homogeneous character of the metal, the entire absence of sand cracks or flaws, and its great cohesive force and elasticity, as compared with the blister steel from which it is made—qualities which it derives solely from its fusion and formation into ingots, all of which properties malleable iron acquires in a like manner by its fusion and formation into ingots in the new process; nor must it be forgotten that no amount of rolling will give to blister steel (although formed of rolled bars) the same homogeneous character that cast steel acquires by a mere extension of the ingot to some ten or twelve times its original length. One of the most important facts connected with the new system of manufacturing malleable iron is, that all the iron so produced will be of that quality known as charcoal iron; not that any charcoal is used in its manufacture, but because the whole of the processes following the smelting of it are conducted entirely without contact with, or the use of any mineral fuel; the iron resulting therefrom will in consequence be perfectly free from those injurious properties which that description of fuel never fails to impart to iron that is brought under its influence. At the same time this system of manufacturing malleable iron offers extraordinary facility for making large shafts, cranks, and other heavy masses. It will be obvious that any weight of metal that can be founded in ordinary cast iron by the means at present at our disposal may also be founded in molten malleable iron, to be wrought into the forms and shapes required, provided that we increase the size and power of our machinery to the extent necessary to deal with such large masses of metal. A few minutes' reflection will show the great anomaly presented by the scale on which the consecutive processes of iron making are at present carried on. The little furnaces originally used for smelting ore have been from time to time increased in size until they have assumed colossal proportions, and are made to operate on two or three hundred tons of materials at a time, giving out ten tons of fluid metal at a single run. The manufacturer has thus gone on increasing the size of his smelting furnaces, and adapting to their use the blast apparatus of the requisite proportions, and has by this means lessened the cost of production in every way. His large furnaces require a great deal less labor to produce a given weight of iron than would have been required to produce it with a dozen furnaces; and in like manner he diminishes his cost of fuel, blast and repairs, while he insures a uniformity in the result that never could have been arrived at by the use of a multiplicity of small furnaces. While the manufacturer has shown himself fully alive to these advantages, he has still been under the necessity of leaving the succeeding operations to be carried out on a scale wholly at variance with the principles he has found so advantageous in the smelting department. It is true that hitherto no better method was known than the puddling process, in which from 400 lb. to 500 lb weight of iron is all that can be operated upon at a time; and even this small quantity is divided into homœopathic doses of some 70 lb. or 80 lb., each of which is moulded and fashioned by human labor, and carefully watched and tended in the furnace, and removed therefrom one at a time, to be carefully manipulated and squeezed into form. When we consider the vast extent of the manufacture, and the gigantic scale on which the early stages of the process is conducted, it is astonishing that no effort

should have been made to raise the after-processes somewhat nearer to a level commensurate with the preceding ones, and thus rescue the trade from the trammels which have so long surrounded it. Before concluding these remarks, I beg to call your attention to an important fact connected with the new process, which affords peculiar facilities for the manufacture of cast steel. At that stage of the process, immediately following the boil, the whole of the crude iron has passed into the condition of cast steel of ordinary quality. By the continuation of the process the steel so produced gradually loses its small remaining portion of carbon, and passes successively from hard to soft steel, and from soft steel to steely iron, and eventually to very soft iron; hence, at a certain period of the process any quality of metal may be obtained. There is one in particular, which, by way of distinction, I call semi-steel, being in hardness about midway between ordinary cast steel and soft malleable iron. This metal possesses the advantage of much greater tensile strength than soft iron. It is also more elastic, and does not readily take a permanent set, while it is much harder and is not worn or indented so easily as soft iron. At the same time it is not so brittle or hard to work as ordinary cast steel. These qualities render it eminently well adapted to purposes where lightness and strength are specially required, or where there is much wear, as in the case of railway cars, which from their softness of texture soon become destroyed. The cost of semi-steel will be a fraction less than iron, because the loss of metal that takes place by oxidation in the converting vessel is about two and a-half per cent. less than it is with iron; but as it is a little more difficult to roll, its cost per ton may be fairly considered to be the same as iron. But as its tensible strength is some thirty or forty per cent. greater than bar iron, it follows that for most purposes a much less weight of metal may be used; so that taken in that way the semi-steel will form a much cheaper metal than any we are at present acquainted with. The facts which I have brought before the Meeting are not mere laboratory experiments, but the result of working on a scale nearly twice as great as is pursued in our largest ironworks—the experimental apparatus doing 7 cwt. in thirty minutes while the ordinary puddling furnace makes only 4½ cwt. in two hours, which is made into six separate balls, while the ingots or blooms are smooth, even prisms, ten inches square by thirty inches in length, weighing about equal to ten ordinary puddle balls.

RESEARCHES IN THE CRIMEAN BOSPHORUS, AND ON THE SITE OF THE ANCIENT GREEK CITY OF PANTICAPŒUM (KERTCH), BY DR. D. MACPHERSON.

The present town of Kertch is built close to the site where 500 years B. C. the Milesians founded a colony. About fifty years before Christ, this colony became subject to Rome, or rather a Satrap of the Roman Empire, from the circumstance of the Bosphorian kings, who were also rulers of Pontus, having been subdued by this people in Asia. In the year 375 of our era, the colony was utterly annihilated by the Huns. Barbarous hordes succeeded one upon another thereafter until A. D. 1280, when the Genoese became possessors of the soil, and held it until expelled by the Turks in 1473; they being in their turn expelled in 1771 by the Russians. The characteristic features around Kertch are the immense tumuli, or artificial mounds that abound in this locality, more especially within the second vallum. These sepulchres of the ancient world are found in many places. We have them in the form of barrows in England, and cairns in Scotland. Calculated as they are for almost endless duration, they present the simplest and sublimest monument that

could have been raised over the dead. The size and grandeur of the tumuli found in this locality excite astonishing ideas of the wealth and power of the people by whom they were erected, for the labour must have been prodigious and the expenditure enormous. The highest specimens of Hellenic art have been discovered in these tumuli—such as sculpture, metal, alabaster and Etruscan vases, glass vessels, remarkable for their lightness, carved ivory, coins, peculiarly pleasing on account of their sharpness and finish, and trinkets, executed with a skill that would vie with that of our best workmen. All originals were forwarded to the Hermitage, at St. Petersburgh, duplicates being preserved in the Museum at Kertch, and these might have been with ease secured to England on the investment of the place by the Allies; but with the exception of some bas-reliefs, which, in connexion with other two officers, I transmitted to the British Museum, the whole of these rare treasures were barbarously made away with. The local tradition is, that these tumuli were raised over the remains, and to perpetuate the memory, of the kings or rulers who held sway over the colonists, and that the earth was heaped upon them annually on the anniversary of the decease of the prince, and for a period of years corresponding to the rank or respect in which its tenant was held, or had reigned; and to this day successive layers of earth, which were laid on in each succeeding year, can be traced in their coating of sea-shell or charcoal having been first put down. I have counted as many as 30 layers in a scarp made in one of those mounds, about two-thirds from its base. They are to be seen of all sizes, varying from 10 to 300 feet in circumference, and in height from 5 to 150 feet, and are usually composed of surface soil and rubble masonry. Herodotus' reference to these sepulchres is the earliest account which history has recorded of this mode of burial; and I would particularly draw your attention to his description of the mode adopted by the Scythians to perpetuate the memory of their deceased princes, for you will hereafter see that one of my excavations corresponded exactly with the description given by him. "The tombs of the Scythian kings," he states, "are seen in the land Gberri, at the extreme point to which the Borysthenes is navigable. Here, in the event of a king's decease, after embalming the body, they convey it to some neighbouring Scythian nation. The people receive the royal corpse, and convey it to another province of his dominions, and when they have paraded it through all the provinces, they dig a deep square fosse, and place the body in the grave on a bed of grass. In the vacant space around the body in the fosse they now lay one of the king's concubines, whom they strangle for the purpose, his cup-bearer, his cook, his groom, his page, his messenger, fifty of his slaves, some horses, and samples of all his things. Having so done, all fall to work, throwing up an immense mound, striving and vying with each other who shall do the most. The Greeks, who always respected the religion of the countries they had subjugated, and who, in process of time, imbibed, to a certain extent, their customs and observances, appear to have adopted this Scythian mode of burial. Instead, however, of placing their magistrates or rulers in a "deep square fosse" dug in the earth, they built tombs, and over these raised the conical hill. But I examined several without meeting with any success. All, or nearly all, of these tumuli have been already explored. Not far from Mons Mithridates I came upon a portion of an aqueduct which probably conveyed water to the Acropolis. It was formed of concave tiles; one of these, with a Greek name thereon, I have brought with me. On one occasion I arrived at the place where five stone tombs were found adjoining, neither of which contained any relic, but in a spot contiguous a large ornamented earthenware jug and five glass

cups, one within the other, were discovered. It was not unusual thus to find the remains in one spot and the ornaments in another. On removing the earth off the sides of a rock, the apex of which was only perceptible on the summit, I struck upon a recess, three sides of a square chiselled out of a rock 16 feet in length and 8 in depth. Following this, I reached a stone seat; hewn out on each side of this seat small recesses had been made, apparently for the purpose of receiving lamps. After descending 12 feet I came to human remains, and for five days the workmen turned nothing out of this pit but human bones. How far these would have descended I know not, for I ceased my explorations here, feeling satisfied, from the appearance of the bones, that they must have been placed there at the same period—the result, most probably, of some great engagement, for many of the skulls and long bones presented fractures and injuries. The marks on the rock would indicate that sacrificial meetings, possibly commemorative of the event, were held here. Replacing these remains, I preceded to a point indicated as the tombs of the diminutive or pigmy race, but discovered nothing that would indicate a peculiar class of people. Beneath an extensive sloping artificial tumulus, running at right angles with the the ridge extending northwards from Mons Mithridates, I came upon a mass of rubble masonry, beyond which was a door leading to an arched chamber, built under the side of the mound. This led me to a larger chamber, which was also arched. The walls of the larger chamber were marked off in squares, with here and there flowers, birds, and grotesque figures. Over the entrance into this chamber were painted two figures of griffins rampant, two horsemen, a person in authority and his attendant—the latter carrying in his hand a long spear—being rudely sketched on one of the inner walls. There were no remains of any sort in this tomb or temple. A recess in the walls on two sides resembled doors blocked up. On removing the masonry to the right the skeleton of a horse was found. To the left a human skeleton lay across the door. Tunnelling on each side, the work was carried on beneath the descents of former explorations from above. On the right-hand side the tunnel extended ten yards, but nothing of interest was met with. On the left, descending as the tunnel was formed, arriving occasionally at objects possessing much interest, I came upon a layer of natural slate rock, the sides and roof of the tunnel being composed of artificial soil, charcoal, animal remains, and, as usual, heaps of broken pottery. Thirty feet from the entrance, the rock suddenly disappeared to the front and left, the mark of the chisel being perceptible on the divided portion. Tunnelling in the rock, we again reached 12 feet from the spot where it had disappeared, loose sand occupying the intervening space, into which the exploring rod, six feet long, dropped without any effort. I worked down into this shaft 12 feet. But the left side of the shaft, which was composed of the same loose sand as far as the steel rod could reach, was continually falling in. Moreover, the labour carried on by candlelight of raising the earth in baskets, and conveying it in wheelbarrows to the outside through the building was becoming very arduous, and I was compelled to abandon the work. At this period no relics or remains of any sort were discovered, and the steel rod sunk into the loose sand as if it had been so much flour. I felt satisfied that this shaft led to rich treasures below, but regard for the safety of my workmen prevented my proceeding deeper. The tunnel was carried on a few feet further, and the earth allowed to drop into the shaft. I now sought out other ground, and selected a place removed about 100 yards from that I had just left. Descending some ten feet, I struck upon a tomb cut out of the solid rock. Not far from this my attention was attracted to an excavation in the rock, somewhat similar

to, but on a much smaller scale, than that large descent which I had just abandoned. Clearing the surface, I found that the rock was hewn out 3 feet in width and 12 in length, the intervening space being filled with sand, similar in all respects to the other into which the steel rod sunk with ease. Fifteen feet of this sand being removed, I came upon the skeleton of a horse. A few feet further on, an upright flag, four feet high, and the breadth of the shaft, was placed over the entrance of a tomb cut out of the calcareous clay. The opening faced the east by an arched door, 24 inches wide and 32 high. The tomb was of a semi-circular form, arched, 10 feet by 12 in diameter, and 8 feet high in the centre. Above the doorway a lintel-stone was placed, on which the slab which closed it rested. The cavity was cut out of the natural calcareous clay, which was firm and consistent, the form and shape of the instrument by which it had been removed being very distinct. The candle burnt brightly on entering. The floor was covered with beautiful pebbles and shells, such as are now found on the shores of the Sea of Azov. A niche was cut out of the walls on three sides, in which lay the dust of what once was human. It was a sight replete with interest to survey this chamber—to examine each article as it had been originally placed more than 2,000 years ago—to contemplate its use, and to behold the effect of 20 centuries upon us proud mortals. There lay the dust of the human frame, possessing still the form of man. The bones had also crumbled into dust; the space once occupied by the head did not exceed the size of the palm of the hand, but in the undisturbed dust, the position of the features could still be traced. The mode in which the garments enveloped the body, and the knots and fastenings by which these were bound, being also distinct. On each niche a body had been placed, and the coffins, crumbled into powder, had fallen in. At the head were glass bottles—one of these contained a little wine. A cup and a lacrymatory of the same material and a lamp were placed in a small niche above. A coin and a few enamelled beads were in the left hand, and in the right a number of walnuts—the wine and nuts being doubtless placed there to cheer and support the soul in its passage to Paradise. Some fibulæ and common ornaments, valuable only on account of their antiquity, were also found. Continuing my researches in the same locality, I came upon other similar shafts, at the end of which were the bones of a horse, and then the large flagstone closed the mouth of tombs similar to the last. I now resolved to made another attempt to explore the great shaft: the only mode of effecting this being to remove entirely that portion of the hill above it, I brought all my labourers to the spot, although the few days that remained of our sojourn in Kertch would hardly enable me, I feared, to complete the work. Placing my men in two gangs, each were made to work half-an-hour without ceasing. On the third day we struck on two large amphoræ, containing each the skeleton of a child between four and six years of age. Underneath these were the tombs of two adults, and then came the skeleton of a horse. There was now every indication that a great feast or sacrifice had been held, for a few feet further on we came upon immense heaps of broken amphoræ, fragments of wine jars, the inside of which were still encrusted with wine lees, broken drinking cups, flat tiles which may have served the purpose of plates, beef and mutton bones, fragments of cooking pots still black from the smoke, and quantities of charcoal. Descending still further, we came upon what appeared to have been a workshop—portions of crucibles in which copper had been smelted, corroded iron, lumps of vitreous glass, broken glass vessels, moulds, and other things being found. Five feet deeper we exposed the excavation in the rock, and a shaft exactly similar to, but on much larger scale than the descent into

the arched tombs. As the hill was removed, platforms were scarped on the sides, on which the earth was thrown up, a man being placed on each platform; and as I descended into the shaft, similar platforms of wood were slung from above. On the twelfth day we reached a depth of 16 feet in the shaft, the portion of the hill removed being 38 feet in length, 20 in depth, and 12 in breadth. The mouth of the shaft hewn out of the rock, 3 feet in thickness, was 18 feet long by 12 broad. It then took on a bell shape, the diameter of which was 22 feet, cut out in dark consistent clay, a depth of nearly 7 feet. Beyond this the size of the shaft became a square seven feet, cut out of successive layers of sandstone and calcareous clay. When we had attained a depth of 30 feet in the shaft, the labour of raising the earth became very great; but by means of a block and shears, which Capt. Commerell, of Her Majesty's ship Snake, very kindly fixed over the descent, the work was much facilitated, the earth being slung up in baskets, and the men ascending and descending in the same manner. A few feet beyond the bones of the horse, and exactly in the centre of the shaft, the skeleton of an adult female appeared enveloped in sea-weed. Under the neck was a lacrymatory, and on the middle finger of the right hand a key-ring. Three feet further we met a layer of human skeletons, laid head to feet, the bones being here in excellent preservation,—as, indeed, we found them to be in all places where the calcareous clay came into immediate contact with them. There were 10 adult male skeletons on this spot, and separated by a foot of clay between each. Five similar layers were found, being 50 in all. I may state that toads in large numbers were found alive in this part of the pit. We had now reached a depth of 42 feet in the shaft, the bones of another horse were turned out, and then we came on loose sand to a depth of 5 feet. Six more skeletons were here again exposed. The sides of the shaft were regular and smooth, the mark of the chisel on the rock being as fresh as when first formed. Six feet more of the loose sand being now taken away, hard bottom could be felt by the steel rod, and there lay two skeletons, male and female, enveloped in sea-weed; and in a large amphora at the corner, which was unfortunately found crushed, were the bones of a child. Some beautiful specimens of pottery, an electrine urn, much broken, lacrymatories, beads and a few coins, were all that I got to repay my labours on this spot. I examined well on every side, and in the rock below, for a trap-door or concealed passage, and an abrupt perpendicular division in the natural strata or layers of calcareous clay appeared to indicate the existence of such, but I found none. Everything during the descent had promised so very favorably, that I fully expected to have found a large chamber leading on from the termination of the shaft; but if such does exist, the discovery of the passage to it utterly baffled all my researches. When the coins I discovered are cleaned, I shall probably be able to fix a date to this wonderful place. The deep fosse, the mode in which the skeletons were found at the bottom, the 5 discovered immediately above these, 50 about the centre, and the bones of the horses, are exactly in harmony with the description of Herodotus of the mode in which the Scythian kings were buried. The substance which I have called sea-weed, from its bearing stronger resemblance to that production than anything else I can compare with it, may possibly be the "grass" described by Herodotus as used to envelope the body. If such be the case, the description is in all respects exact. There was now no time to enter upon fresh explorations.

THE ARCTIC CURRENT AROUND GREENLAND, BY CAPT. IRLINGER, R. D. N.

Many hydrographers assert that a current from the ocean around Spitzbergen continues its course along the east coast of Greenland, and thence in a nearly

straight line towards the banks of Newfoundland. In this opinion I do not agree. Considerable quantities of ice are annually brought with the current from the ocean around Spitzbergen to the south and south-west along the east coast of Greenland, around Cape Farewell, and into Davis Strait. These enormous masses of ice are frequently drifted so close to the southern part of the coast of Greenland that navigation through it is impossible. To demonstrate the existence of this ice-drift, I may mention the following extract from the log-book of the schooner Activ, Capt. J. Andersen. This vessel belongs to the colony of Julianehaab, and is used as a transport in this district:—7th of April, 1851, the Activ left Julianehaab, bound to the different establishments on the coast between Julianehaab and Cape Farewell. The same day the captain was forced by the ice to take refuge in a harbour. Frequent snow-storms and frost. On account of icebergs and great masses of floe ice inclosing the coast, it was impossible to proceed on the voyage before the 23rd, when the ice was found to be more open; but after a few hours' sailing the ice again obliged the captain to put into a harbour. Closed in by the ice until the 27th. The ice was now open, and the voyage proceeded until the *1st of May*, when the ice compelled him to go into a harbour. In this month violent storms, snow and frost. From the most elevated points ashore very often no extent of sea visible; now and then the ice open, but not sufficiently so for proceeding on the voyage. At last, on *the 6th of June*, in the morning, the voyage was continued; but the same evening the ice inclosed the coast, and the schooner was brought into "Blisshullet," a port in the neighboured of Cape Farewell. The following day the voyage was pursued through the openings between the ice; and on the 18th of June the schooner arrived again at Julianehaab. Whilst the masses of ice, as above mentioned, inclosed the coast between Juliannehaab and Cape Farewell, the brig Lucinde crossed the meridian of Cape Farewell on the 26th of April, in lat. 58° 3' N. (101 nautical miles from shore), and no ice was seen from the brig before the 2nd of May, in lat. 58° 26' N., and 50° 9' W. of Greenwich. Further, Capt. Knudten, commanding the Neptune, bound from Copenhagen to Julianehaab, was obliged, on account of falling in with much ice, to put into the harbour of Frederikshaab on the 8th of May, 1852, and was not able to continue his voyage to Julianehaab before the middle of June, because a continuous drift-ice (icebergs as well as very extensive fields) was rapidly carried along the coast to the *northward.* Capt. Knudten mentions, that during the whole time he was closed in at Frederikshaab he did not a single day discover any clear water even from the elevated points ashore, from which he could see about 28 nautical miles seaward. Whilst the Neptune was inclosed by the ice at Frederikshaab, the brig Balder, on the home passage from Greenland to Copenhagen, crossed the meridian of Cape Farewell on the 9th of June in lat. 58° 9' N. (100 miles from shore) in clear water, and no ice in sight. From the above it is evident that the current from the ocean around Spitzbergen, running along the east coast of Greenland past Cape Farewell, continues its course along the western coast of Greenland to the north, and transports in this manner the masses of ice from the ocean around Spitzbergen into Davis Strait. If the current existed, which the before-named writers state to run in a direct line from East Greenland to the banks of Newfoundland, then the ice would likewise be carried with that current from East Greenland; if it were a submarine current, the deeply-immersed icebergs would be transported by it; if it were only a surface-current, the immense extent of field-ice would indicate its course, and vessels would consequently cross these ice-drifts at whatever distance they passed to the southward of Cape Farewell. *But*

this is not the case: experience has taught that vessels coming from the eastward, steering their course about 2° (120 nautical miles) to the southward of Cape Farewell, seldom or never fall in with ice before they have rounded Cape Farewell and got into Davis Strait, *which is a certain proof that there does not exist even a branch of the Arctic current which runs directly from East Greenland towards the banks of Newfoundland.*

EXPLORATIONS THROUGH THE VALLEY OF THE ATRATO TO THE PACIFIC IN SEARCH OF A ROUTE FOR A SHIP CANAL, BY MR. F. M. KELLEY, OF NEW YORK.

Several surveying expeditions have been sent by Mr. Kelley into this region, and much valuable information has resulted. But the chief result is a conviction of the feasibility of a ship-canal through the isthmus. The most recent of Mr. Kelley's explorers, Mr. Kennish, proposes to enter the Atrato by the Cano Coquito. The greatest depth on the bar is about 4 ft. at low water; the soundings gradually deepen and become 30 ft. within 2 miles, when the depth increases to 47 ft., and s nowhere less up to the Truando. The width varies from a quarter of a mile to 2 miles, and the removal of the bar would allow of the transit of the largest steamers. The confluence of the Truando is about 63 miles from the Gulf, and that river forms the channel of the proposed line for 36 miles. The line then follows the valley of the Nerqua through rock-cutting, and passes the summit by a tunnel of $3\frac{1}{4}$ miles. It reaches the Pacific through the valley of a small stream, and debouches at Kelley's Inlet. In the valley of the Atrato, 300 miles long and 75 broad, and lying between the Antiochian mountains on the east and the Cordillera of the Andes on the west, rain falls almost daily; which accounts for the immense supply of water in that region. On the Pacific side of the Cordillera there is scarcely any rain for eight months of the year. The greater portion of the rain falling in the Atrato valley is caught above the confluence of the Truando. Fifteen large tributaries and numerous smaller streams fall into the Atrato and contribute to the immense lagoons, which form natural reservoirs and a superabundant store of water throughout the year. There are various cogent reasons or selecting the confluence of the Truando as the best point from whence the passage from the Atrato to the Pacific may be effected. In the first place there is no point of junction with the Atrato by western tributaries so near the level of high water on the Pacific as that of the Truando. It happens to be 9 ft. above the Pacific at high water, and it is therefore of sufficient elevation to prevent the Paific at high water from flowing through the proposed cut into the Atrato; while it is not so high as to cause the current from the Atrato to the Pacific at *low* water to pass through the cut too rapidly. In fact, the elevation of the Truando confluence just preserves a preponderating balance on the side of the Atrato. The Atrato, at the junction of the Salaqui, is only 1 ft. above the level of the Pacific at high water; but the dividing ridge is 1,063 ft. high and 30 miles wide, according o a survey of that route by Mr. Kennish and Mr. Nelson. Should any of the rivers at the mouth of the Atrato be selected, without reference to the height and width of the dividing ridge, it may be observed that the maximum tidal wave in the Paific being 25 ft. and that on the Atlantic only 2 ft., the Pacific at high tide would flow into the Atlantic with a current equal to a head of $11\frac{1}{2}$ ft.; and at low water in the Pacific the Atlantic would flow into it with a similar current. In the inlet sf the Gulf of Micuel, recently called Darien Harbour, the action of the tide is so trong, that H. B. M. steamship Virago, commanded by Capt. Prevost, dragged

both anchors ahead, and was only brought up by paying out nearly all her cable. The heights of the tides and levels of the two oceans have been well established by the recent observations of Col. Totten in Navy Bay on the Atlantic and in a deep bend of the Bay of Panama on the Pacific. On the Atlantic a consecutive series of thirty-two observations were taken in the months of August and September during the season of calms. On the Pacific two sets of observations were made. The first, during May and June, when fifty-four consecutive tides were observed in a season of calms: and the second in November and December, when fifty-two consecutive tides were observed in a season of light winds. The results do not exactly correspond, and are given in the following table:—

	Pacific.		Atlantic.
	May and June.	Nov. and Dec.	Aug. and Sept.
Greatest rise of tide	17·72	21.30	1·60
Least	7·94	9·70	0·63
Average	12·08	14·10	1·16
Mean tide of Pacific above mean tide of Atlantic..	0·759	0·140	
High spring tide of Pacific above high spring tide of Atlantic	9.40	10·12	
Low spring tide of Pacific *below* low spring tide of Atlantic	6·55	9·40	
Mean high tide of Pacific above mean high tide of Atlantic	6 25	6·73	
Mean low tide of Pacific *below* mean low tide of Atlantic	4·73	5·26	
Average rise of spring tides	14·08	17·30	
Average rise of neap tides	9·60	12·40	

These observations make the mean level of the Pacific from 0·14 to 0·75 higher than the mean level of the Atlantic; but this is probably owing only to local circumstances, and it may be assumed that there is no difference in the mean levels of the two oceans. The conclusions arrived at by the successive independent surveys carried out at the expense of Mr. Kelley may be summed up as follows:—First, That the oceans can be united through the Atrato and Truando by a canal without a lock or any other impediment. Second, That while the distance between the oceans by this route is only 131 miles, half that distance is provided by nature with a passage for the largest ships. Third, The remaining distance requires the removal of bars, excavations, and cuttings, presenting no unusual difficulties. Fourth, Harbours, requiring but little improvement to render them excellent, exist at the termini.

ON ISOTHERMAL LINES, BY PROFESSOR HENNESSY.

The author discusses the distribution of those lines in islands. Considering an island having its shores bathed by a warm oceanic current, the isothermals, if the direct solar radiation were abstracted, would be closed curves surrounding the centre of the island and related to the coast-line, their shapes being variously modified by ranges of mountains, inequalities in the surface, and prevalent winds. By now introducing the effect of solar radiation it follows from the mathematica theory of heat, that the entire quantity of heat received by a unit of surface of

the island will depend on two principal terms: one, a function of the distance of the point from the coast, and capable of being expressed in some cases as a function of the difference of latitude of that point and the nearest point on the coast, and, secondly, of a term depending on the latitude and on an elliptic function of the second order, having for its modulus the line of the obliquity of the equator. The effect of solar radiation will therefore be to transport the centres of all the closed isothermals towards the pole of the hemisphere in which the island lies; and some of these lines may thus ultimately terminate at the coast with their convex sides turned towards the equator, while others may still continue as closed curves in the interior of the island. The observations collected by Dr. Lloyd in his "Meteorology of Ireland" confirm this theory.

Dr. Lloyd remarked that the influence of the Gulf Stream in elevating the temperature of the coast-stations in Ireland was one of the first results that presented itself in the discussion of the observations referred to, but the inland stations were not numerous enough to form the basis of deduction as to the law of the actual distribution of temperature. He had therefore formed the isothermals from the coast observations, and had compared the inland temperature calculated from these with the observed. This comparison had shown that the effect of the Gulf Stream was even greater than had been anticipated, the temperature over the sea exceeding that over the land by nearly 4° Fah., being more than the utmost due to geographical position alone. Hence it was plain that the actual isothermals must be closed curves, but the case of Ireland, bathed as it was by the waters of a heated sea, cannot be taken as a type of the general phenomena of island temperature. According to Dufresney, the temperature of the sea was generally higher than that of the air above it, but the difference was very small except in the regions of heated currents flowing from a warmer zone.

ON THE ECLIPSE OF THE SUN IN HERODOTUS.

The Rev. Dr. Hincks has introduced a discussion on the eclipse that Herodotus describes as terminating a battle between the Medes and Lydians. This was supposed by Bayer in 1728, to have been the eclipse of May 18th, 603 B.C., but this view was opposed by Baily in 1811, who argued for the eclipse of Sept. 30, 610 B.C. Baily was, however, confuted by Mr. Hind, who has shown that the shadow would fall nearly 10° to the north of Baily's computation, and who falls back on the eclipse of May 28th, 585 B.C. Dr. Hincks conceived this to be an error, and was in favor of the original eclipse of Bayer, viz,—on May 18th, 603 B.C., and intimated a desire to learn what the actual track of this eclipse was according to the most modern tables of the moon.

Dr. Whewell on this remarked that this very eclipse and the whole ground over which Dr. Hincks had travelled had already been fully investigated by the Astronomer Royal in the R. S. Transactions for 1850. M. Bosanquet writes to the *Athenæum* (Aug. 23rd) that "not only the track of the eclipse of 603 B.C. but of every eclipse bearing upon the question between the years 630 and 580 B.C. has been examined by the Astronomer Royal, and the result of his investigations published in the *Phil. Trans.* for 1852, which had been entirely overlooked by Dr. Hincks:" also, that Mr. Hind in 1852 had shewn the eclipse of 585 B.C. to be the only one satisfying all the conditions: that, however, a short time back, the error discovered in Planche's tables had led to a re-calculation of the path for 585 B.C. and the alteration necessary was found to be very slight, so as not to

invalidate the conclusion that this must be the eclipse of Herodotus. In reply Dr. Hincks writes to the *Athenæum* (Oct. 25) that Dr. Whewell and Mr. Bosanquet are both mistaken: that the paper by the Astronomer Royal in the *Phil. Trans.* for 1853 contains no calculation for the eclipse of 603 B.C. but only for that of 585 B.C. which latter is inconsistent with known historical facts: the former (603) has never been calculated since Mr. Baily's paper in 1811; and it is known that the tables used by Mr. Baily are defective. Dr. Hincks believes that the error in the moon's longitude introduced by adopting this eclipse will be found consistent with those pointed out by Mr. Adams to exist in Damoiseau's tables, and, after throwing back on Dr. Whewell the imputation of ignorance, again impresses on astronomers the necessity of re-calculating the track for 603 B.C. There the matter rests for the present.

THE MOON'S ROTATION.

Mr. Jelinger Symons, one of "Her Majesty's Inspectors of Schools," communicated to *The Times* not long ago a grand discovery he had made, viz.—that astronomers were all wrong in supposing the moon to have a rotation round its axis. Undeterred by the universal reclamation that assailed him, he brought the subject forward at the British Association, following a paper read by Dr. Whewell on the subject with one of his own, entitled "On Phenomena recently discovered in the Moon." The "recently discovered phenomena" consisted only of his previous assertion, with the addition, that the proper mode of describing the moon's motion was to say that she rotated "round a line, not exactly passing through the earth but near it." He illustrated his position by a machine, which however, was seen, by those capable of analysing its motions, to contradict its author. Unfortunately for himself, this gentleman travelled out of his subject into another department in an incidental sentence, when he stated, as a proof how necessary it was to correct the statements in which philosophers sometimes indulged, that it was now asserted that there were not large assemblages of water upon the moon, whereas Newton has not only traced out her seas, but had actually calculated the heights of the lunar tides—Mr. Symons thus interpreting "lunar tides" to mean tides on the moon instead of tides on the earth caused by the attraction of the moon.

Innumerable illustrations have been given of this motion of the moon for the purpose of rendering this purely geometrical conception familiar to minds not versed in geometry, but we do not remember to have met with the following—viz: that a spectator on the moon has just the same reason to attribute a motion round its axis to his moon, as an earthsman has to his earth: for he will find his meridian passing successively through every quarter of the heavens and completing a revolution once a month, just as a spectator on the earth finds his meridian passing through every quarter of the heavens once in a siderial day; the result being in each case the same, namely, an apparent motion of the heavens from east to west completing a revolution, in the case of the earth, in one day, in that of the moon, in one lunation; and, necessarily, the interpretation of such apparent motion being also the same.

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(*Concluded.*)

ACOUSTICS AS APPLIED TO PUBLIC BUILDINGS, BY PROFESSOR HENRY, OF THE SMITHSONIAN INSTITUTION.

At the meeting of the American Association, in 1854, I gave a verbal account of a plan of a lecture room adopted for the Smithsonian Institution, with some remarks on acoustics as applied to apartments intended for public speaking. At that time the room was not finished, and experience had not proved the truth of the principles on which the plan had been designed. Since then the room has been employed for two winters for courses of lectures to large audiences, and I believe it is the universal opinion of those who have been present that the arrangement for seeing and hearing, considering the size of the apartment, is entirely unexceptionable. It has certainly fully answered all the expectations which were formed in regard to it previous to its construction.

The President of the United States directed Capt. Meigs to confer with Prof. Bache and myself in regard to the acoustics of the new rooms in the ante-room of the Capitol. Previous to this we first studied the peculiarities of the present hall of the House of Representatives. This is allowed to be one of the worst possible apartments for public speaking; and to determine the cause of the confusion of sounds which exists during debate, is of considerable importance in suggesting improvements in the arrangement of the new rooms. We afterwards examined the principal churches and halls in Philadelphia, New York and Boston, and the peculiarities of these, as far as the investigation extended, may be referred to a few well established principles of sound which have been applied to the construction of this lecture room. To apply them generally, however, in the construction of public halls requires a series of preliminary experiments.

In every small apartment it is an easy matter to be heard distinctly at every point but in a large room, unless from the first in the original plan of the building provision be made on acoustic principles for a suitable form, it will be difficult, and indeed in most cases impossible, to produce the desired result. The same remark may be applied to lighting, heating and vantilation, and to all the special purposes to which a particular building is to be applied. I beg, therefore, to make some preliminary remarks on the architecture of buildings bearing on this point, which, though they may not meet with universal acceptance, will, I trust, commend themselves to the common sense of the public in general.

In the erection of a building, the uses to which it is to be applied should be clearly understood, and provision definitely made for every desired object.

Modern architecture is not a fine art par excellence, like painting or sculpture, the object of the latter is to produce a moral emotion, or awaken the feelings of the sublime or the beautiful, and we egregiously err when we apply their productions to a merely utilitarian purpose. To make a fire screen of Rubens' Madonna, or a candelabrum of the statue of the Apollo Belvidere, would be to debase these exquisite productions of genius, and to do violence to the feelings of the cultivated lover of art. Modern buildings are made for other purposes than artistic effect, and in them the æsthetical must be subordinate to the useful; then the two may coexist, and an intellectual pleasure be derived from a sense of adaptation and fitness, combined with a perception of harmony of parts and the beauty of detail.

The buildings of a country should be an ethnological expression of the wants,

habits, art and sentiment of the time in which they are erected. Those of Egypt, Greece and Rome were intended at least in part, without the art of printing, to transmit to posterity an idea of the character of the periods in which they were erected. It was by such monuments that these nations sought to impress an idea of their religious and political sentiment on future ages.

The Greek architect was untrammelled by any condition of utility. Architecture was with him, in reality, a fine art. The temple was formed to gratify the popular deity. The minutest parts were exquisitely finished, since nothing but perfection on all sides, and in the smallest particular, can gratify an all seeing and critical eye. It was intended for external worship, and not internal use. It was without windows, and entirely open to the sky, or if closed with a roof the light was merely admitted through a large door. There were no arrangements for heating or ventilation. The uses, therefore, to which, in modern times, buildings of this kind can be applied, are exceedingly few; and though they were objects of great beauty and fully realised the intention of the architect when originally constructed, yet they cannot be copied in our days without violating the principles which should govern in architectural adaptation.

Every vestige of ancient architecture which now remains on the face of the earth should be preserved with religious care; but to servilely copy those, and to attempt to apply them to the uses of our day, is as preposterous as to attempt to harmonize the refinement of civilization of the present age with the superstition of the times of the Pharaohs. It is only when a building expresses the dominant sentiment of an age, when a perfect adaptation to its use is joined to harmony of proportions and an outward expression of its character, that it is entitled to our admiration. It has been aptly said that it is one thing to adopt a particular style of architecture, but a very different one to adapt it to the purpose intended.

Architecture should not only change with the character of the people, and in some cases with the climate, but also with the material to be employed in construction. The introduction of iron and of glass requires an entirely different style from that which sprung from the caves of Egypt, the masses of marble from which the lintels of the Grecian temples are formed, or the introduction of brick by the Romans.

The great tenacity, and power of resistance to crushing, of iron as a building material, should point out for it a far more slender and apparently lighter arrangement of parts. An entire building of iron, fashioned in imitation of stone, might be erected at small expense of invention on the part of the architect, but would do little credit to his truthfulness or originality. The same may be said of our modern pasteboard edifices, in which, with their battlements, towers, pinnacles, "fretted roofs and long drawn aisles," cheap and transient magnificence is produced by painted wood or decorated plaster. I must not, however, indulge in remarks of this kind, but must curb my feelings in regard to this subject, since I speak from peculiar experience.

But to return to the subject of acoustics as applied to apartments intended for public speaking. While sound, in connection with its analogies with light, and in its abstract principles, has been investigated within the last fifty years with a rich harvest of results, few attempts have been successfully made to apply these principles to practical purposes. Though we may have a clear idea of the abstract operation of a law of nature, yet when the conditions are varied and the actions multiplied, the results frequently transcend our powers of logic, and we are obliged

to appeal to experiment and observation, not only to assist in deducing consequences, but also to verify those which have been arrived at by logical deduction. Furthermore, though we may know the manner in which a cause acts to produce a given effect, yet in all cases we are obliged to ascertain the measure of effect under given conditions.

The science of acoustics as applied to buildings, perhaps more than any other, requires this union of scientific principles with experimental deductions. While on the one hand the simple deductions from the established principles of acoustics would be unsafe from a want of knowledge of the constants which enter into our formula, on the other hand empirical data alone are in this case entirely at fault, and of this any person may be convinced who will examine the several works written on acoustics by those who are deemed practical men.

Sound is a motion of matter capable of affecting the ear with a sensation peculiar to that organ. It is not in all cases simply a motion of the air, for there are many sounds in which the air is not concerned. For example, the impulses which are conveyed along a rod of wood from a tuning fork to the teeth. When a sound is produced by a single impulse, or an approximation to a single impulse, it is called a noise—when a series of impulses, a continued sound, &c.; if the impulses are equal in duration among themselves, a musical sound. This has been illustrated by a quill striking against the teeth of a wheel. A single impulse from one tooth is a noise, from a series of teeth in succession a continued sound, and if all the teeth are at equal distances, and the velocity of the wheel is uniform, then a musical note is the result. Each of these sounds is produced by the human voice, though they apparently run into each other. Usually, however, in speaking, a series of irregular sounds of short duration are omitted—each syllable of a word constitutes a separate sound of appreciable duration, and each compound word and sentence an assemblage of such sounds. It is astonishing that in listening to a discourse the ear can receive so many impressions in the course of a second, and that the mind can take cognizance of and conquer them.

That a certain force of impulse, and a certain time for its continuance are necessary to produce an audible impression on the ear is evident; but it may be doubted whether the impression of a sound on this organ is retained appreciably longer than the continuance of the impulse itself. Certainly not longer than the 1-10th of a second. If this were the case, it is difficult to conceive why articulate discourse which so pre-eminently distinguishes man from the lower animals, should not fill the ear with a monotonous hum; but whether the ear continues to vibrate, or whether the impression remains a certain time on the *sensorium*, it is certain that no sound is ever entirely instantaneous, or the result of a single impression, particularly in inclosed spaces. Every impulse must give rise to a forward, and afterwards to a backward motion of the atom. The impulse is not only communicated to the ear but to all bodies around, which, in turn, themselves become centres of reflected impulses.

Sound, from a single explosion in air equally elastic on all sides, tends to expand equally in every direction; but when the impulse is given to the air in a single direction, through an expansion taken place on all sides, it is much more intense in the line of the impulse. For example, the impulse of a single explosion, like that of the detonation of a bubble of oxygen, is propagated equally in all directions; while the discharge of a cannon, while heard on every side, is much louder in the direction of the axis; so, also, a person speaking is heard much more distinctly in

front than at an equal distance behind. Many experiments have been made on this point, and I may mention those repeated in the open space in front of the Smithsonian Institution. In a circle one hundred feet in diameter, the speaker in the centre and the hearers in succession at different points of the circumference, the voice was heard distinctly directly in front, gradually less so on either side, until in the rear it was scarcely audible. The rates of distance for distinct hearing directly in front, on the sides, and in the rear, were about as 100, 75 and 30.

Those numbers may serve to determine the form in which an audience should be arranged in an open field, in order that those on the periphery of the space may all have a like favorable opportunity of hearing, though it should not be recommended as the interior form of an apartment, in which a reflecting wall would be behind the speaker.

The impulse producing sound requires time for its propagation, and thus depends upon the intensity of repulsion among the atoms; and, secondly, on the specific purity of the matter itself. If the medium were entirely rigid, sound would be propagated instantaneously. The weaker the repulsion between the atoms, the greater will be the time required to transmit the motion from one to the other; and the heavier the atoms the greater will be the time required for the action of a given force to produce in them a given amount of the motion. Sound, also, in meeting an obstacle, is reflected in accordance with the law of light, making the angle of incidence equal to the angle of reflection. The tendency, however, to a divergency in a single beam of sound, appears to be much greater than that in the case of light. The law, however, appears to be definitely observed in the case of all beams that are reflected in a direction near the perpendicular. It is on the law of the propagation and reflection of sound, that the philosophy of echo depends Knowing the velocity of sound, it is an easy matter to calculate the interval of time which elapses between the original impulse and the return of the echo. Sound moves at the rate of 1,125 feet in a second at the temperature of 60 degrees. If, therefore, we stand at half this distance before a wall, the echo will return to us in one second. It is, however, a fact known from universal experience, that no echo is perceptible from a near wall, though one in all cases must be sent back to the ear; the reason of this is that the ear cannot distinguish the difference between the similar sounds, as, for example, that from the original impulse and its reflection, if they follow each other at less than a given interval, which can only be determined by actual experiment; and as this is an important element in the construction of buildings, the attempt was made to determine it, with some considerable degree of accuracy. For this purpose the observer was placed immediately in front of the wall of the west end of the Smithsonian building, at the distance of 100 feet; the hands were then clapped together; a distant echo was perceived, the elapsed time of the passage of the impulse from hand to ear, and that from the hand to the wall and back to the ear was sufficiently great to produce two entirely distinct impressions. The observer then gradually approached the building until no echo or perceptible prolongation of the sound was observed. By accurately measuring this distance, and doubling it, we find the interval of space within which two sounds may follow each other without appearing separately. But if two rays of sound reach the ear, without having passed through distances differing from each other greater than this, they produce the effect of separate sounds. This distance we have called the limit of perceptibility in terms of space. If we

divide this distance into the velocity of sound, we ascertain the limit of perceptibility in time.

In the experiment just made with the wall, a source of error was discovered, in the fact that a portion of the sound returned was reflected from the cornice under the eaves, and as this was at a greater distance than the part of the wall immediately perpendicular to the observer, the moment of the cessation of the echo was less distinct. In subsequent experiments with a louder noise the reflection was observed from a perpendicular surface of about twelve feet square, and from this more definite results were obtained. The limit of the distance in this case was about thirty-five feet, varying slightly, perhaps, with the intensity of the sound and the acuteness of different ears. This will give about one-sixteenth of a second as the limit of time at which the ear can separately distinguish two similar sounds. From this experiment we learn that the reflected sound may tend to strengthen the impression or to confine it, according as the difference of time between the two impressions is greater or less than the limit of perceptibility. An application of the same principle gives us the explanation of some phenomena of sound which have been considered mysterious. Thus, in the reflection of an impulse from the edge of a forest of trees, each leaf properly situated within a range of thirty feet of the front plane of reflection, will conspire to produce a distinct echo, and these would form the principal part of the reflecting surfaces of a dense forest, for the remainder would be screened, and being a greater distance every ray which might come from them would serve to produce merely a low continuation of the sound.

On the same principle we may at once assert that the pannelling of a room, or even the introduction of reflecting surfaces at different distances, will not prevent the echo, provided they are parallel to each other, and situated relatively to each other within the limit of perceptibility.

Important advantage may be taken of the principle of the reflection of sound by the proper arrangement of the reflecting surfaces behind the speaker. We frequently see in churches, as if to diminish the effect of the voice of the preacher, a mass of drapery placed directly in the rear of the pulpit. However important this may be in an æsthetical point of view, it is certainly at variance with correct acoustic arrangements—the great object of which should be to husband every articulation of the voice, and to transmit it unmingled with their impulses, and with as little loss as possible to the ears of the audience.

Another effect of the transmission and reflection of sound, is that which is called reverberation, which consists of a prolonged musical sound, and is much more frequently the cause of indistinctness of perception of the articulations of the speaker than the single echo.

Reverberation is produced by repeated reflection of a sound from the walls of the apartment. If, for example, a single detonation takes place in the middle of a long hall, with naked and perpendicular walls, an impulse will pass in each direction, will be reflected from the walls, cross each other again at the point of origin, be again reflected, and so on until the original impulse is entirely absorbed by the solid materials which confine it. The impression will be retained upon the ear during the interval of the transmission past it of two successive waves, and thus a continued sound will be kept up, particularly if the walls of any part of the room are within thirty-five feet of the ear. If a series of impulses, such as those produced by the rapid snaps of the teeth of a wheel against a quill, be

made in unison with the echoes, a continued musical sound will be the result. Suppose the wheel to be turned with such velocity as to cause a snap at the very instant the return echo passes the point at which the apparatus is placed, the second sound will combine with the first, and thus a loud and sustained vibration will be produced. It will be evident from this that every room has a key note, and that if an instrument be sounded on this, it will resound with great force. It must be apparent also that the continuance of a single sound and the tendency to confusion in distinct articulation will depend on several conditions—first, on the size of the apartment; second, on the strength of the sound, or the intensity of the impulse; third, on the position of the reflecting surface; and, fourth, on the nature of the material of the reflecting surfaces.

In regard to the first of these, the larger the room, the longer time will be required for the impulse to reach the wall along the axis; and if we suppose that at each collision a portion of the original force is absorbed, it will require double the time to totally extinguish it in a room of double the size, because the velocity of sound being the same, the number of collisions in a given time will be inversely as the distance through which the sound has to travel.

Again, that it must depend upon the loudness of the sound, or the insecurity of the impulse must be evident, when we consider that the cessation of the reflections is due to the absorption of the walls, or irregular reflection, and that consequently the greater the amount of original disturbance the longer will be the time required for its complete extinction. This principle was abundantly shown by our observations on different rooms.

Thirdly, the continuance of the resonance will depend upon the position of the reflecting surfaces. If these are not parallel to each other, but oblique, so as to reflect the sound, not to the opposite but to the adjacent wall, without passing through the longer axis of the room, it will evidently be sooner absorbed. Any obstacle also which may tend to break up the wave and interfere with the reflection through the axis of the room, will serve to lessen the resonance of the apartment. Hence, though pannelling the ceiling and introducing a variety of oblique surfaces may not prevent an isolated echo, provided the distance be sufficiently great and the sound sufficiently loud, yet that they do have an important effect in stopping the resonance is evident from theory and experiment. In a room fifty feet square, in which the resonance of a single intense sound continued six seconds, when cases and other objects were placed around the wall, its continuance was reduced to two seconds.

Fourthly, the duration of the resonance will depend on the nature of the material of the wall. A reflection always takes place at the surface of a new medium, and the amount of this will depend on the elastic force or power to resist compression and the density of the new medium. For example, a wall of nitrogen, if such could be found, would transmit nearly the whole of a wave of sound in air, and reflect but a very small portion. A partition of tissue paper would produce nearly the same effect. A polished wall of steel, however, of sufficient thickness to prevent yielding, would reflect, for practical purposes, all the impulses through the air which might fall upon it. The rebound of the wave is caused, not by the oscillation of the wall, but the elasticity and mobility of the air. A single ray of sound striking against a yielding board would probably increase the loudness of the reverberation, but not its continuance. On this point a series of experiments were made by the use of the tuning fork. In this instrument the motion of the foot

and of the two prongs give a sonorous vibration to the air, which, if received upon another tuning fork of precisely the same size and form, would reproduce the same vibrations.

It is a fact well established by observation, that when two bodies are in perfect unison, and separated from each other by a space filled with air, the vibrations of the one will be transmitted to the other. From this consideration it is probable that very nearly the same effect ought to be produced in transmitting immediately the vibration of a tuning fork to a reflecting body as to duration and intensity, as in the case of transmission through air. This conclusion is strengthened by floating a flat piece of wood in a vessel of water standing upon a sounding board; placing a tuning fork on this, the vibrations will be transmitted to the board through the water, and sounds will be produced of the same character as those emitted when the tuning fork is placed directly on the board. A tuning fork was suspended from a fine cambric thread, vibrated in air, and, from the mean of a number of experiments, was found to continue in motion 252 seconds. In this experiment, had the tuning fork been in a perfect vacuum, suspended without the use of a string, and further, had there been no etherial medium, the agitation of which would give rise to light, heat, electricity, or some other form of etherial motion, the fork would continue its vibration forever.

The fork was next placed upon a large thin pine board—the top of a table. A loud sound, in this case, was produced, which continued less than ten seconds. The whole table, as a system, was thrown into motion, and the sound produced was as loud on the under side as on the upper side. Had the tuning fork been placed upon a partition of this material, a loud sound would have been heard in the adjoining room; this was proved by sounding the tuning fork against a door leading into a closed closet. The sound within was apparently as loud as that without.

The rapid decay of sound in this case was produced by the great amount of the motive power of the fork being communicated to a large mass of wood. The increased sound was due to the increased surface. In other words, the shortness of duration was compensated for by the greater intensity of effect produced.

The tuning fork was next placed upon a circular slab of marble, about three feet in diameter and three-fourths of an inch thick; the sound emitted was feeble, and the undulations continued 115 seconds, as deduced from the mean of six experiments.

In all these experiments, except the one in vacuum, the time of the cessation of the tuning fork was determined by bringing the mouth of a resounding cavity near the end of the fork; this cavity, having previously been adjusted to unison with the vibrations of the fork, gave an audible sound when none could be heard by the unaided ear.

The tuning fork was next placed upon a cube of India rubber, and this upon the marble slab. The sound emitted in this case was scarcely that in the case of the tuning fork suspended from the cambric thread; and from this anology of the previous experiments we might at first thought suppose the time of duration would be great—but this was not the case; the vibrations continued only forty seconds.

The question may here be asked what became of the impulses lost by the tuning fork? They were neither transmitted to the India rubber, nor given off to the air in the form of a sound, but were probably expended in producing a change in the matter of the India rubber, or were converted into heat, or both. Though the inquiry did not fall strictly within the line of this series of investigations, yet

it was of so interesting a character, in a physical point of view, to determine whether heat was actually produced, that the following experiment was made:—

A cylindrical piece of India rubber, about $1\frac{1}{4}$ inches diameter, was placed in a tubulated bottle with two openings, one near the bottom and the other at the top; a stuffing box was attached to the upper, through which a metallic stem, with a circular foot to press upon the India rubber, was made to pass, air tight. The lower tubular was closed with a cork, in the perforation of which a fine glass tube was cemented; a small quantity of red ink was placed in the hole to serve as an index. The whole arrangement thus formed a kind of thermometer, which would indicate a certain amount of change of temperature in the inclosed air. On the top of the stem the tuning fork was screwed, and consequently its vibrations were transmitted to the rubber within the bottles. The glass was surrounded with several coatings of flannel to prevent the influence of the external temperature. The tuning fork was then sounded, and the vibrations were kept up for some time. No reliable indications of an increase of temperature were observed. A more delicate method of making the experiment next suggested itself. The tube containing the drop of red ink, with its cork, was removed, and the point of a compound wire formed of copper and iron was thrust into the substance of the rubber, whilst the other ends of the wire were connected with a delicate galvanometer. The needle was suffered to come to rest. The tuning fork was then vibrated, and its impulses transmitted to the rubber. A very perceptible increase of temperature was the result. The needle moved through an arc from one to two and a half degrees. The experiment was varied, and many times repeated; the motions of the needle were always in the same direction, viz: in that which was produced when the point of the compound wire was heated by momentary contact with the fingers. The amount of heat generated in this way is, however, small, and, indeed in all cases in which it is generated by mechanical means, the amount evolved appears very small in comparison with the labor expended in producing it. Jule has shown that the mechanical energy generated in a pound weight, by falling through a space of 750 feet, elevates the temperature of a pound of water one degree.

It is evident that an object like India rubber actually destroys a portion of the sound, and hence in cases in which entire non-conduction is required, this substance can probably be employed with perfect success.

The tuning fork was next pressed upon a solid brick wall. The duration of vibration, from a number of trials, was eighty-eight seconds. Against a wall of lath and plaster the sound was louder, and continued only eighteen seconds.

From these experiments we may infer that if a room were lined with a wainscot of thin boards, and a space left between the wall and the wood, the loudness of the echo of a single noise would be increased, while the duration of the echo would be diminished. If, however, the thin board were glued or cemented in solid connection to the wall, or embedded in the mortar, then the effect would be a feeble echo, and a long continued resonance similar to that from the slab of mable. This was proved by first determining the length of continuance of the vibrations of a tuning fork on a thin board, which was cemented to a flat piece of marble.

A series of experiments were next commenced with reference to the actual reflection of sound. For this purpose a parabolic mirror was employed, and the sound from a watch received on the mouth of a hearing trumpet, furnished with a tube for each ear. The focus was near the apex of the parabola, and when the watch was suspended at this point, it was six inches within the plane of the outer

circle of the mirror. In this case the sound was confined at its origin and prevented from expanding. No conjugate focus was produced, but, on the contrary, the rays of light, when a candle was introduced, constantly diverged. The ticking of the watch could not be heard at all when the ear was applied to the outside of the mirror, while directly in front it was distinctly heard at the distance of thirty feet, and, with the assistance of the ear trumpet, at more than double that distance. When the watch was removed from the focus the sound ceased to be audible. This method of experimenting admits of considerable precision, and enables us to directly verify, by means of sound transmitted through air, the results anticipated in the previous experiments. A piece of tissue paper placed within the mirror, and surrounding the watch without touching it, slightly diminished the reflection. A simple curtain of flannel produced a somewhat greater effect, though the reflecting power of the metallic parabola was not entirely masked by the thicknesses of flannel, and I presume very little change would have been perceived had the reflector been lined with flannel glued to the surface of the metal. The sound was also audible at the distance of ten feet, when a large felt hat, without stiffening, was interposed between the watch and the mirror. Care was taken in these experiments so to surround the watch that no ray of sound could pass directly from it to the reflecting surface.

With a cylindrical mirror with parabolic base very little increased reflection was perceived. The converging beams were merely in this case in a simple plane perpendicular to the mirror, and passing through the ear, while, to the focal point of the spherical mirror, a solid cone of rays was sent.

The reflection from the cylindrical mirror forms what is called a "caustic" in optics, while that from a spherical mirror gives a true focus, or, in other words, collects the sound from all parts of the surface and conveys them to one point of space. These facts furnish a ready explanation of the confusion experienced in the Hall of Representatives, which is surmounted by a dome, the under surface of which acts as an immense concave mirror, reflecting to a focus every sound which ascends to it, leaving other points of space deficient in sonorous impulses.

Water and other liquids, which offer great resistance to compression, are good reflectors of sound. This may be shown by the following experiment:—When water is gradually poured into an upright cylindrical vessel, over the mouth of which a tuning fork is vibrated until it comes within a certain distance of the mouth, it will reflect an echo in unison with the vibrations of the fork, and produce a loud resonance. This result explains the fact, which had been observed with some surprise, that the duration of the resonance of a newly plastered room was not perceptibly less than that of one which had been thoroughly dried.

There is another principle of acoustics which has a bearing on this subject. I allude to the refraction of sound. It is well known that when a ray of sound passes from one medium to another, change in velocity takes place, and consequently a change in the direction or refraction must be produced. The amount of this can readily be calculated where the relative velocities are known. In rooms heated by furnaces, and in which streams of heated air passed up between the audience and speaker, a confusion has been supposed to be produced, and distinct hearing interfered with by this course. Since the velocity of sound in air at 32 degrees of Fahrenheit has been found to be 1,090 feet in a second, and since the velocity increases 1.14 feet for every degree of Fahrenheit, if we know the temperature of the room and that of the heated current, the amount of angular refraction can be

ascertained. But since the ear does not readily judge of the difference of direction of two sounds emanating from the same source, and since two rays do not confuse the impression which they produce upon the ear, though they arrive by very different routes, provided they are within the limit of perceptibility, we may therefore conclude that the indistinctness produced by refraction is comparatively little. Professor Bache and myself could perceive no difference in distinctness in hearing from rays of sound passing over a chandelier of the largest size, in which a large number of gas jets were in full combustion. The fact of disturbance from this cause, however, if any exist, may best be determined by the experiment with a parabolic mirror and the hearing trumpet before described.

These researches may be much extended; they open a field of investigation equally interesting to the lover of abstract science and to the practical builder, and I hope on behalf of the committee, to give some further facts with regard to this subject at another meeting.

I will now briefly describe the lecture room which has been constructed in accordance with the facts and principles stated above, so far, at least, as they could be applied.

There was another object kept in view in the construction of this room besides the accurate hearing; the distinct seeing. It was desirable that every person should have an opportunity of seeing the experiments which might be performed as well as hearing distinctly the explanation of them.

By a fortunate coincidence of principles, it happens that the arrangements for ensuring unobstructed sight do not interfere with those necessary for distinct hearing.

The law of Congress authorizing the establishment of the Smithsonian Institution directed that a lecture room should be provided, and accordingly in the first plan one-half of the first story of the main building was devoted to this purpose. It was found, however, impossible to construct a room on acoustic principles in this part of the building which was necessarily occupied by two rows of columns. The only suitable place which could be found was therefore on the second floor. The main building is 200 feet long and 50 feet wide; but by placing the lecture room in the middle of the story a greater width was obtained by means of the projecting towers.

The main gallery is in the form of a horse shoe, and occupies three sides of the room. The speaker's platform is placed between two oblique walls. The corners of the room which are cut off by these walls afford recesses for the stairs into the galleries. The opposite corners are also partitioned off so as to afford recesses for the same purpose.

The ceiling is twenty-five feet high, and therefore within the reach of perceptibility. It is perfectly smooth and unbroken, with the exception of an oval opening near the platform, through which light is admitted.

The seats are arranged in a curved form, and were intended to rise in accordance with the panoptic curve originally proposed by Professor Bache, which enables every individual to see over the head of the person immediately in front of him. The original form of the room, however, did not allow of this intention being fully realised, and therefore the rise is rather less than the curve would indicate. The general appearance of the room is somewhat fan-shaped, and the speaker is placed as it were in the mouth of an immense trumpet. The sound directly from his voice, and that from reflection immediately behind him, is thrown forward upon

the audience, and as the difference of the distance travelled by the two rays is much within the limit of perceptibility, no confusion is produced by direct and reflected sound. No echo is given off from the ceiling, for this is also within the limit of perceptibility, while it assists the hearing in the gallery by the reflection to that place of the oblique rays.

Again, on account of the oblique walls behind the speaker, and the multitude of surfaces, including the gallery pillars, stair screens, &c., as well as the audience, directly in front, all reverberation is stopped.

The walls behind the speaker are composed of lath and plaster, and therefore have a tendency to give a more intense though less prolonged sound than if of solid masonry. They are also intended for exhibiting drawings to the best advantage.

The architecture of this room is due to Captain Alexander, of the Corps of Topographical Engineers. He fully appreciated all the principles of sound which I have given, and varied his plans until all required conditions, as far as posssible, were fulfilled.

CANADIAN INSTITUTE.

Session—1856-57.

FIRST ORDINARY MEETING—*Saturday, 6th December*, 1856.

E. A. Meredith, Esq., LL.B., Vice President, in the Chair

The following Gentlemen, provisionally elected by the Council during the recess, were Balloted for and declared duly elected Members ;

A. T. Augusta, Esq., Yonge St., Toronto.
Robt. Armour, Esq., Bowmanville, C. W.
Isaac Buchanan, Esq., Hamilton, C. W.
James Brown, Esq., Toronto, C. W.
J. Beatty, Junr., Esq., M. D., Cobourg, C. W.
G. G. Bird, Esq., M. D., Bowmanville, C. W.
Rev. R. G. Cox, Wellington, P. E. District, C.W.
Ed. Fitzgerald, Esq., Toronto, C. W.
A. J. Fergusson, Esq., M.P.P., Guelph, C. W.
Rev. Robt. Irvine, D.D., Hamilton, C. W.
Edgar J. Jarvis, Esq., Toronto, C. W.
Rev. Professor Kendall, Trinity College, Toronto, C. W.
Rev. J. Laing, Scarborough, C. W.
H. H. Meredith, Esq., Port Hope, C. W.
Dan. McLellan, Esq., Hamilton, C. W.
John McBride, Esq., Toronto, C. W.
Revd. D. Pierce, Kingston, C. W.
J. P. Russell, Esq., M.D., Quebec, C. E.
J. W. Tate, Esq., Belleville, C. W
W. G. Tomkins, Esq., C. E., Hamilton, C. W,
Major F. Wells, 1st Royal Regiment of Foot.
Rev. W. S. Darling, Toronto, C. W.
Hon. L. T. Drummond, M. P. P. Montreal, C. E.

William Hewson, Esq., Whitby, C. W.
R. Sandars, Esq., Trinity College, Toronto, C. W.
Dr. Charles Sewell, Toronto, C. W.
J. F. Smith, Toronto, (Junior Member).

The donations to the Library and Museum received since the last ordinary meeting, were laid upon the table. The Secretary was instructed to include a record of them in the Annual Report, and to communicate the thanks of the Institute to the Donors for their valuable contributions.

Professor Cherriman gave the requisite notice of motion of an amendment to Regulation 4. Sec. II., touching the amount payable to constitute Life Membership; and Dr. Wilson to Regulation 1. Sec. VII., for the addition of a third Vice-President to the office bearers in accordance with the terms of the Charter.

The following Papers were read:

1. By Capt. William Kennedy:

"On the proposed expedition to the Arctic Regions in further search of the records or remains of Sir John Franklin."

2. By the Rev. W. A. Adamson, D.C.L.:

"On the decrease, restoration, and preservation of the Salmon in Canada."

SECOND ORDINARY MEETING—13*th December,* 1856.

James Bovell, M. D., Vice-President, in the Chair.

The following Gentlemen were elected Members:

Thomas M. Clark, Esq., Toronto.
Hon. James Patton, M.A., Barrie, C. W.
Beverly Robinson Morris, Esq., M. D., Toronto.
W. Loring Cillery, Esq., Toronto.
William Shirrefs, Esq., Toronto.
A. S. Kirkpatrick, Esq., Toronto.
Christopher Paterson, Esq., Barrister, Toronto.

The following Donations were then announced, and the thanks of the Institute voted to the Donors:

From the Secretary of the School of Mines, Paris:

Annales des Mines, 5e Serie, Tome VI. 5e Livraison de 1854—55.
Do. do. VII. 1re, 2e, 3e Livraison de 1855.

From the Regents of the University *ex-officio* Trustees of the State Library, in behalf of the State of New York.

Documents relating to the Colonial History of the State of New York. Vols. III., IV. and VII.

Annual Report of the Trustees of the New York State Library, 22nd January, 1856.

Science and Religion—Sermon delivered in Albany during the Session of the American Association for the advancement of Science: by the Rev. Bishop Hopkins, D.D.

Religious Bearing of Man's Creation. Discourse delivered in Albany during the Session of the American Association for the advancement of Science: by Edward Hitchcock, D.D., LL.D.

From D. Appleton & Co., New York—

Milledulcia ; A Thousand Pleasant Things selected from "Notes and Queries."

From Harper & Brothers, Publishers, New York—

New Granada—Twenty Months in the Andes, by Isaac F. Holton, M. A., with maps and illustrations.

Beaumarchais and his Times—French Society in the Eighteenth Century, by Louis de Leménie, translated by Henry S. Edwards.

Lake Ngami—Wanderings in South Western Africa, by Charles J. Andersson.

From A. H. Armour, Esq.,—

Almanach de Gotha, 1856.

Montreal in 1856, a Sketch prepared for the Opening of the Grand Trunk Railway of Canada ; Pamphlet.

From Rev. J. M. Phillippo, per Prof. Croft—

Transactions of the Society of Arts, Jamaica, for year 1854-5.

The following Communications were read:

1. By Professor Chapman:

"A description of some Trilobites found at Whitby ; illustrated by specimens."

2. By James Gilbert:

"On the Arizara Copper Mine, accompanied with specimens of Ore from the California Mines."

The requisite nominations of office-bearers for the ensuing year were made, and the Vice-President announced that on the following Saturday, the Annual General Meeting would take place at Seven P. M., to receive the report of the Council, elect the officers and members of Council for the ensuing year, and for other business.

ANNUAL GENERAL MEETING—*Saturday, 20th December,* 1856.

E. A. Meredith, LL.B., Vice-President, in the Chair,

The following Gentlemen were elected Members :

Hugh Thomson, Esq., Toronto,
James W. Dunsford, Esq., Verulam, C. W.
Charles F. Gildersleeve, Esq., Toronto.
William Baldwin Sullivan, Esq., Toronto.
John Head, Toronto. *(Junior Member.)*

The following Communications were read:

1. By Professor Croft, D. C. L.,:

"Notes on the Oxalate of Manganese."

2. By Joseph Robinson, Esq.,:

"On a Process for Preserving Timber from Decay."

3. By James Bovell, M. D.,:

"On Cell Developement."

4. By R. T. Pennefather, Esq.,:

"Notes of a Journey made by Governor Simcoe, from Niagara to Detroit, in 1793."

Prof. Cherriman, in accordance with previous notice, moved:

That Rule 4, Sec. II., shall be amended by erasing the sum of £7 10s. and substituting therefor £10, as the sum payable by Members for Life—Carried.

Dr. Wilson, in accordance with previous notice, moved :

That in Rule 7, of Section II., the words "and third" be added after "second" so as to admit of the election of a third Vice-President in accordance with the provisions of the Charter.—Carried.

The Report of the Council for the year 1855-56, was then read as follows :

ANNUAL REPORT OF THE COUNCIL, 1856.

The Council of the Canadian Institute have the honor to submit the following Report of the proceedings of the Institute during the past year.

The Council have the highest satisfaction in announcing that upwards of one hundred and fifty names have been added to the list of Members since the date of the last Annual Report, and that the accessions thus made to the numerical strength of the Institute indicate not only local, but widely spread interest and co-operation.

The total number of Members of the Institute now amount to five hundred, of whom it may be interesting to note that there are: 370 residents of Toronto, 162 of other parts of Upper Canada, 33 of Lower Canada, and 10 Foreign Members: thus establishing the Institute as provincial rather than local in its character.

The Council have continued to make such additions to the Library by purchase as the funds at their command would seem to justify ; and they trust that those additions, comprising nearly one hundred volumes of completed Works—independent of periodical literature—will commend their efforts in this particular to the approval of the Institute.

The Council have great pleasure in submitting the list of Donations made to the Library during the past year, indicative not only of extended interest in this important branch of our efforts, but illustrating continued and very remarkable liberality on the part of Donors to whom the Institute had before been largely indebted. Although anxious to avoid invidious references where so many are entitled to the acknowledgments of the Institute, the Council are warranted in particularly noting the generous contributions of the Honorable J. M. Brodhead of Washington, a valuable donation, including 25 volumes; of Mr. Bohn of London, England, including 58 volumes ; and of Dr. Chewett of Toronto, including 57 volumes ; to each of whom the Institute is especially indebted for large and very valuable additions to its collection, of a class of works peculiarly suited to the objects which the Institute is chiefly designed to promote. By the various additions thus made to the Library, its value for the purposes of reference has been considerably increased, and it now embraces a collection of upwards of seventeen hundred volumes, the great majority of which are of a scientific or practical character.

In the last annual Report for the year 1855-6, the Council expressed their regret that no addition to the Museum had been made during the year then closing. It is therefore with greater satisfaction that the Council have now to acknowledge the receipt of contributions :—the list of which, embracing various specimens in Geology and Natural History, and a small collection of fifty-five silver coins, including those of Edward II., III., and VI., and Queen Elizabeth, will be enumerated in the classified catalogue,—not only because of the value attaching to these donations, but as justifying the hope that the collection may be early augmented to a standard of usefulness.

The practical value of such collections depends so largely on facility for reference, that members of the Council have engaged in the preparation of classified catalogues of the Library and Museum—and such measures have been taken as warrant the assurance that these will be completed for use during the present session.

The Council have further to announce that, in fulfilment of the conditions annexed to the acquisition of the valuable library of the Athenæum, referred to in last Report, arrangements have been effected under which the public may visit and consult the Library of the Institute daily between the hours of three and five o'clock; and that a book has been opened wherein Members are invited to enter the title of any work which they recommend to the Council for purchase.

By these measures it is hoped that the Library, already of very considerable value, may become of more direct and continuous utility to our members and the public at large, whilst the interest thus excited may direct attention, not only to its possessions, but to its deficiencies, and thus may result in increasing and more general efforts in aid of its extension, as well as in the augmentation of the Institute's collections of specimens of Natural History, Minerals, and other objects of scientific interest and value, so as ultimately to render both the Library and Museum creditable to the Institute and beneficial to the Province at large.

In submitting the list of communications read at the meetings of the Institute during the session, 1855-56, the Council are gratified in being able to note that, whilst the number of papers read last year was largely in excess of that reported for the preceding session, the proportion emanating from the general body of Members of the Institute, as distinguished from Members of the Council, has also been considerably augmented : an evidence of growing co-operation which the Council regard as most important and satisfactory; and giving promise, as they trust, of still further and more effective manifestation of activity during future Sessions.

Prof. Croft, D. C. L.—"On the Hydrates of Hydro Sulphuric Acid. 1st December, 1855.

Prof. Wilson, LL. D.—"On displacement and extinction among the Primeval Races of Man." 1st December, 1855.

Prof. Chapman.—"On a method of representing Crystaline Forms." 8th December, 1855.

Prof. Bovell, M. D.—"On some points in the Natural History of the Leech." 15th December, 1855.

J. G. Hodgins, Esq,—"On a specimen of the Proteus of the Lakes." 15th December, 1855.

Capt. Noble, R. A., F. R. S.—"On the value of the Factor in the Hygrometric Formula." 12th January, 1856.

Professor Cherriman, M. A.—"On a method of reducing the general equation of the second degree in Plane Co-ordinate Geometry." 12th January, 1856.

Professor Chapman.—"Report of the Committee appointed to examine the specimen of the Proteus exhibited before the Institute." 12th January, 1856.

Prof. Croft, D. C. L.—"On some new salts of Cadmium and on the Iodides of Barium and Strontium." 12th January, 1856.

Rev. Prof. Young, M. A.—"On Professor Ferrier's Theory of Knowing and Being." 19th January, 1856.

Major Lachlan.—"Communication relative to a simultaneous system of Meteorological observations throughout the Province, including a letter on the subject from Prof. Henry, Secretary of the Smithsonian Institute." 19th January, 1856.

G. W. Allan, Esq.—"The President's Address." 26th January, 1856.

J. G. Hodgins, Esq.,—"On the steps which have been taken by the Educational Department to establish a System of Meteorological Stations throughout Upper Canada." 26th January, 1856.

W. D. Campbell, Esq.—A method of determining the errors below 32° Fahr. of mercurial Thermometers which have been compared and corrected above the freezing point." 26th January, 1856.

Prof. Wilson, LL.D.—"Traces of the Ancient Miners of Lake Superior." 26th January, 1856.

J. Brown, Esq.—"On the Aborigines of Australia." 2nd February, 1856.

Prof. Kingston, M. A.—"Meteorological Report for 1855." 2nd February, 1856.

Rev. Prof. Young, M. A.—"Brief Notes on certain statements of Sir Wm. Hamilton, regarding the validity of our Primary Beliefs." 9th February, 1856.

Prof. Wilson, LL.D.—"Remarks on a singular conformation of the land, produced by the confluence of the St. Louis and Nemagi Rivers into Lake Superior." 9th February, 1856.

Prof. Chapman.—"Report on Minerals lately received from the Toronto Athenæum." 9th February, 1856.

G. W. Allan, Esq., President.—"On the Migratory Birds of Canada." 16th February, 1856.

J. Brown, Esq.—"On the Manners and Customs of the Aborigines of Australia." 2nd part. 16th February, 1856.

Thos. Reynolds, M. D.—"On a collection of Copper implements found in the neighbourhood of Brockville." 16th February, 1856.

S. Fleming, Esq., C. E.—"The Geological Survey of Canada." 23rd February, 1856.

Prof. Chapman.—"On the Classification of Trilobites." 23rd February, 1856.

Rev. A. C. Geikie.—"An enquiry into the Causes of Deterioration in the population of New England." 23rd February, 1856.

P. MacGregor, Esq.—"On the Climate of Canada." 1st March, 1856.

Prof. Wilson, LL.D.—"On the Pictured Rocks of Lake Superior." 1st March, 1856.

Prof. Croft, D. C. L.—"On the specific gravity and analysis of Copper Instruments found in the neighbourhood of Brockville." 1st March, 1856.

Prof. Hind, M. A.—"On the Blue Clay of Toronto." 8th March, 1856.

Jos. Robinson, Esq.—"On Fish Jointing on the permanent way of Railroads." 8th March, 1856.

Prof. Croft, D. C. L.—"On the construction of a safety Camphene Lamp." 8th March, 1856.

Rev. Prof. Young, M. A.—"A new proof of the Parallelogram of Forces." 15th March, 1856.

T. C. Keefer, Esq., C. E.—"On Civil Engineering." 15th March, 1856.

Colonel Baron de Rottenburgh.—"Some observations on the supposed Self-Luminosity of the Planet Neptune." 29th March, 1856.

A. Brunel, Esq., C. E.—"Economy of Fuel for Steam Machinery." 29th March, 1856.

Paul Kane, Esq.—"On the habits and customs of the Walla-Wallas, one of the North American Indian Tribes;" from the Author's Journals. 5th April, 1856.

Prof. Chapman.—"Brief Notices by Lieut. Maury, of Washington, on some comparative phenomena of the North and South Atlantic Oceans." 5th April, 1856.

Prof. Chapman.—"Some Fossil specimens from the Crimea exhibited and described." 5th April, 1856.

E. A. Meredith, LL.B.—"Influence of the recent Gold Discoveries on Prices." 19th April, 1856.

Prof. Bovell, M. D.—"On the Varieties of the Human Race." 26th April, 1856.

P. MacGregor, Esq.—"On the physiological character of the climate of North America." 26th April, 1856.

In view of the successful character of the Canadian section of the Exhibition of the Industry of all Nations at Paris, in 1856, and especially of that portion of it entrusted to Sir Wm. Logan: and of the honors which had been conferred upon him by Her Majesty, by the Emperor of the French, and by the learned Societies of England and France, the Institute determined to accord such a welcome on his return to Canada, and such congratulations on his well-earned and richly merited dignities, as would be fitting from this Society to him as its first President, and expressive of the esteem in which he is held by its Members.

The necessary preliminary measures having been taken, Sir William Logan was invited to be present at a meeting of the Institute held on the 5th April, 1856—when an address of congratulation was presented to him by the President, G. W. Allan, Esq. This address, together with the reply of Sir Wm. Logan, have already been recorded, and published in the Transactions of the Institute; and, together with a portrait of him by which its rooms are now adorned, remain as enduring mementos of the appreciation of the Society of the services which he has rendered to Science, and the honor and benefits he has conferred on Canada by his successful researches as a practical Geologist.

Attached hereto will be found the Report of the Editing Committee nominated by the Council to conduct the Canadian Journal—submitting a statement of their procedings during the past year, and their views in reference to the important duty entrusted to them.

To that document the Council desire to direct the special attention of the Institute—and in doing so to congratulate its members on the steady and increasing success of the publication, which they feel justified in regarding as the most essential and promising element of the future prosperity and usefulness of the Institute.

The scheme for a New Series of the Journal submitted in the last Annual Report, and subsequently authorized by the Institute, has been carried into effect with, as the Council venture to believe, very satisfactory results.

The public criticism of the work has been favorable, its form has been approved as convenient, and its circulation has increased, while the expense of its publication is considerably reduced. Much of this is undoubtedly due to the high character which attached to the earlier series of the Journal, the experience gained by its

issue, and the excellent basis thus formed for the more mature work; yet much is also to be attributed to the services and indefatigable zeal of the General Editor, Dr. Wilson, under whose direction the work has been issued, along with the valuable and effective co-operation of his coadjutors, of whose joint labors the Members have already enjoyed abundant opportunities of judging for themselves.

The practice adopted by the Council in reference to the former series of the Journal, of placing it in the hands of the trade for general sale, having been found to be attended with much trouble, without any adequate advantages to repay the care of looking after booksellers' accounts, and the returns of agents for copies on sale, the Council have adopted the practice—usually acted upon by Scientific Societies at Home, with their Transactions,—of printing the Journal exclusively for distribution among the Members of the Institute, and such Institutions and Societies as they may transmit it to in gift, or exchange for their publications. As the annual payment of four dollars from Members resident in Toronto, and of three dollars from country Members, is not more than the Journal of the Institute may be considered fully worth,—in addition to the other advantages which resident Members enjoy,—this arrangement has in no degree checked the increasing circulation of the Journal, while it has materially contributed to the large addition of new Members above referred to. The only exception which the Council have deemed it advisable to make to this rule is, that Members are permitted to purchase additional copies, and Provincial Literary and Scientific Societies to subscribe for the Journal by an annual payment in advance, at the same rate as the subscription required from non-resident Members.

The experience of the Council during the past year has fully confirmed them in the wisdom of this course, and they accordingly recommend that it be adhered to, and that the new series of the Journal be continued and permanently adopted in its present form; and they have much satisfaction in announcing that Dr. Wilson has consented to continue his services as Editor in Chief during the ensuing year. With a view to meet the rapidly increasing numbers of the Institute, the Council instructed the Editing Committee to increase the new edition of the Journal from seven hundred and fifty—the number of the former series—to one thousand copies; of these about six hundred and fifty have been distributed, and the remainder are in reserve to meet the demands consequent on the future extension of the Institute, and the exchanges which its rapidly extending relations with foreign Societies may require.

EDITING COMMITTEE'S REPORT.

The Committee appointed to edit the new series of the Canadian Journal, beg leave to submit to the Council the following Report of their proceedings during the past year.

In accordance with the instructions of the Council, as set forth in the scheme prepared and published in the Annual Report for 1855, the duties of the Editing Committee were classified and divided among its members.

The organization of this Committee having only taken place at the close of last year, and their duties being further complicated by the transfer of the printing of the Journal to a different firm from that formerly employed, some delay necessarily took place in the first number; and difficulties were occasioned to the Editing Committee on more than one subsequent occasion by impediments entirely beyond their control, such as the want of the requisite fonts of type, especially for some of the scientific papers of a special character. But these and other obstacles to

the regular publication of the Journal are now, it is hoped, no longer likely to interfere with its issue at the appointed periods.

From the Treasurer's accounts it appears that the entire cost of printing the Journal for the year 1856, including illustrations, postages, &c., for an edition increased to one thousand copies, amounts to £257 0s. 9½d.* and in reference to this your Committee would only draw attention to the fact that nearly the whole of the matter being original, printed from the authors' manuscripts, and subject to their revision and corrections, it is mainly owing to the exertions of those Editors of the various sections who have gratuitously superintended the correction of the press, that this source of former outlay no longer occurs; but that, on the contrary, a considerable increase in this department of necessary expenditure has been avoided.

In the six numbers for 1856, constituting the first volume of the New Series of the Canadian Journal, twenty-nine original papers have been printed, twenty-four of which have been selected from the communications made to the meetings of the Institute during last session. Of the twenty-three Reviews accompanying these, twenty have been contributed by members of the Editing Committee; and they have much pleasure in acknowledging the valuable services rendered to them, and to the Institute, by the contributions of the Rev. Professor Young, and Professor Buckland to this department. In carrying out the fourth head of the scheme adopted for the new series of the Journal, which required "all matter derived from published sources, to be printed in small type, and to form a distinct division or appendix," your Committee have appended to each number a section entitled Scientific and Literary Notes; but it will be found that only a small portion of this is borrowed from published sources. It has already, on more than one occasion, embodied the first notice of original discoveries or observations, and has regularly included translations and careful abstracts on one or more branches of Science, from Home and Foreign Journals; so that your Committee venture to hope this section of the Journal will be regarded by many of its readers as not the least valuable of its contents.

The Editing Committee earnestly invite contributions from the members at large. The departments of Natural History, Geology and Mineralogy, Natural Philosophy, and Engineering, might be greatly enriched by short notices derived from personal observation, throughout the various districts of this widely extended Province; and to all the sections of the Journal it must be in the power of many members to furnish additions of general interest and value. For those which embrace subjects connected with the Ancient Races and the early historical monuments of this Continent, communications are specially desired. Probably no season passes over without the disclosure of some remains of the Aboriginal possessors of the land, accompanied with evidences of ancient arts, customs, or sepulchral rites; and it is a matter of great moment, and calculated to confer a permanent value on the Journal as a book of reference, that such should be accurately noted and recorded as they occur. The same observations apply to the Fauna and Flora of the Continent, which are unquestionably disappearing from many localities, now encroached upon by the clearings of new settlers: and

* The difference between this statement of the actual cost of the Journal, in the Report of the Editing Committee, and that embodied in the Treasurer's Report, arises from the latter charging the Journal, as in former years, with one-half of the Assistant Secretary's salary

concerning the former habitats of which, notices put on record now, will hereafter possess an ever increasing value. Further, the Editing Committee would urge on all the members of the Canadian Institute the duty of aiding to secure the communication of materials requisite to make this periodical alike creditable to the Society and useful to the Province.

In thus summing up their first year's labors, and inviting future co-operation, it is with sincere regret that the Committee have to record the loss to the Institute, as well as to themselves, of two esteemed coadjutors, whose services have contributed to the interest of the Journal during the past year. The recall of Captain Noble, R. A., by whom the admirable Meteorological Reports have hitherto been furnished for Quebec, will, it is feared, bring that valuable series of returns to a close; while in the resignation by the Rev. G. C. Irving, of the Chair held by him in Trinity College, Toronto, and his subsequent departure for Europe, the Editing Committee, and the members of the Institute at large, have lost a fellow-laborer, whose absence will long be felt to create a blank in their meetings.

DAN. WILSON, Convener.

Toronto, November 1, 1856.

TREASURER'S REPORT, 1856.

Statement of Canadian Institute General Account for 1856.

Cash Balance from last year	£273	17	8			
" received from Members	346	17	10			
" " for sale of Journal	36	13	0			
" " Government Grant	250	0	0			
" " Athenæum	150	0	0			
				£1,057	8	6
Arrears due the Institute by Members for 1852	4	2	6			
" " " 1853	4	15	0			
" " " 1854	8	7	6			
" " " 1855	27	3	9			
" " " 1856	68	5	0			
				112	13	9
Cash due the Institute for sales of the Journal, Old Series	47	5	0			
Cash due the Institute for sales of the Journal, New Series	42	6	3			
				89	11	3
				£1,259	13	6
Cash paid on account to publication of the Old Series of the Journal	150	1	3			
" " " New Series	182	15	10			
" " " Library	123	19	7			
" " General Account	239	5	4			
" transferred to Building Fund	150	0	0			
Balance due by Institute to the General Account	10	12	3			
" " " Library	5	1	6			
" " " Journal	111	13	10			
				973	9	7
Estimated balance in favor of the Institute				£286	3	11

Statement of Building Fund Account.

Balance from 1855	1000	0	0			
Cash received by subscriptions in 1856	211	10	0			
Cash transferred from the General Account	150	0	0			
				1361	10	0
Disbursements as per Vouchers				92	4	3
Total Cash Balance				£1269	5	9
Cash due on Subscription List				534	15	0
Interest due on Cash Invested				94	13	3
Estimated Balance in favor of the Building Fund				£1898	14	0

The Treasurer in account with the Canadian Institute.

Dr.						
Balance of Building Fund from 1855	1000	0	0			
Cash received by Subscription to Building Fund	211	10	0			
" Balance of General Account from 1855	273	17	8			
" received from Members	351	12	10			
" " Government Grant	250	0	0			
" " Athenæum	150	0	0			
" " Sales of Journal	31	18	0			
				£2,268	18	6
Cr.						
Cash paid on account of the publication of Old						
" Series of the Journal	150	1	3			
" " " New Series	182	15	10			
" " Library	123	19	7			
" " General Account	239	5	4			
" " New Building	92	4	3			
				788	6	3
" Invested				1389	6	8
" Balance in Bank of Upper Canada				91	5	7
				£2,268	18	6

D. Crawford,
Treasurer.

When the Council assumed office, they, with the Members of the Institute generally, indulged the hope that during the past summer some progress might have been made in the erection of the new building; when, however, they came to consider in detail the provision which must necessarily be made, the expenditure which it involved, and the entire insufficiency of the funds at command to secure such progress as would justify active measures during the season, they were reluctantly compelled to abandon any attempt to proceed with the structure during the present year. The calls upon the public from other quarters had been so pressing and continuous, that the Council feared the prosecution of their appeal for aid under the circumstances would have been productive of injury to the scheme. They preferred therefore rather to await a more promising opportunity for calling in subscriptions, than to urge their claims at a period which such efforts as they made abundantly manifested to be so unpromising; and they were further induced to this decision, by the reflection that whilst the funds already in their

possession would continue to fructify, they might confidently rely upon additions to them by future Parliamentary Grants, as well as by the increased liberality of individual subscribers when less intruded upon by rival appeals. Having then secured such amount as will suffice for the objects in view, they anticipate the time as not far distant when the Institute may engage in the work free from the risk of debt, and without the apprehension of the depressing and perhaps disastrous influence which such could scarcely fail to have on the Institute.

The Council trust that these views will meet with the entire concurrence of the Members of the Institute, and that the motives by which they were governed in adopting, after the most anxious and mature deliberation, the course of procedure here referred to, may stimulate the members and friends of the Institute to such active co-operation and liberality in their contributions as will justify the construction of the building during the ensuing summer, and enable the successors of the present Council, in presenting their next Report, to congratulate the Members on its speedy completion, if not to present it to them, assembled in their own Hall.

F. W. CUMBERLAND,
Secretary.

Toronto, 6th December, 1856.

AUDITOR'S REPORT, 1856.

We, the undersigned, beg to report to the Council of the Canadian Institute, that we have examined the Cash Book and compared the Vouchers with the items of expenditure recorded, which agree. There appears to be a Balance in the Treasurer's hands of ninety-one pounds five shillings and sevenpence currency, and invested by the Treasurer, upon securities exhibited to us, one thousand three hundred and eighty-nine pounds six shillings and eightpence.

J. STEVENSON,
HERBERT MORTIMER, } *Auditors.*

Toronto, 9th December, 1856.

The Report was unanimously adopted.

The Chairman having appointed Mr. Sheriff Jarvis and Mr. S. Fleming as scrutineers, the ballot for Election of Officers for the ensuing year was proceeded with, and

The following Gentlemen were declared duly elected;

President, the Hon. Chief Justice DRAPER, C. B.

1st Vice President,	Professor E. J. CHAPMAN.
2nd do	Col. BARON DE ROTTENBURG.
3rd do	JOHN LANGTON, M.A.
Treasurer,	D. CRAWFORD.
Corresponding Secretary,	THOS. HENNING.
Recording do	J. GEORGE HODGINS, M.A.
Librarian,	Prof. CROFT, D.C.L.
Curator,	Prof. HIND, M.A.
Council,	Prof. WILSON, LL.D.
" Prof.	CHERRIMAN, M.A.
"	E. A. MEREDITH, LL.B.
"	S. B. HARMAN, Esq.,
"	Rev. Professor YOUNG, M.A.
"	JAMES BOVELL, M.D.

The following Donations to the Museum were announced, and the thanks of the Institute voted to the Donors:

From Mr. Bethune, Walpole:—

A Pair of Insects. (Phasma.)

From Mr. W. Couper, Toronto:

55 specimens, of 42 Species of Insects, viz:

				Exotic Coleoptera:
9	Specimens,	4	Species,	Cincindelidæ,
15	"	9	"	Carabidæ,
1	"	1	"	Scarites,
1	"	1	"	Silpha,
1	"	1	"	Hister,
1	"	1	"	Blaps Mortisaga,
2	"	1	"	" "
4	"	4	"	Curculionidæ,
1	"	1	"	Lixus,
1	"	1	"	Bostrichus,
1	"	1	"	Clerus,
2	"	2	"	Cerambycidæ,
1	"	1	"	Donacia,
1	"	1	"	Hispa,
10	"	9	"	Chrysomelidæ,
2	"	2	"	Cassidæ,
2	"	2	"	Coccinellidæ.
55		42		

Also,

1 " Blatta and 1 Hymenopterous Insect—exotic.

THIRD ORDINARY MEETING.—10*th January*, 1857.

The Hon. Chief Justice DRAPER, C.B., President, in the Chair.

The following Gentlemen were elected Members:

ROBERT SNELLING, Esq., Toronto.
REV. SALTERN GIVENS, Yorkville.
ALEX. MANNING, Esq., Toronto.
JAMES GRAND, Esq., Toronto.
WILLIAM PROUDFOOT, Esq., Hamilton.
SAML. H. STRONG, Esq., Toronto.
GEO. F. DUGGAN, Toronto, (Junior Member.)

The following Donations to the Library and Museum were announced, and the thanks of the Institute voted to the Donors:

From the Author:

Sketch of the Montreal Celebration of the Grand Trunk Railway of Canada, by W. Baldwin Sullivan, Esq.

From the Hon. J. M. Brodhead, per A. H. Armour, Esq.,:

"United States Japan Exhibition, vol. III."

"Patent Office Reports, 1855."

From the Author, per A. H. Armour, Esq.,:

"An Overland Journey round the World in the years 1841, and 1842," by Sir George Simpson.

From Phillips, Sampson & Co.:

"Prescott's Robertson's History of Charles V.," three volumes.

"Religious Truths, illustrated from Science," by E. Hitchcock, D.D., LL.D.

From John Head, Esq.:

"A large Stone Gouge."

The President's ANNUAL ADDRESS was delivered by the Hon. Chief Justice Draper, C.B.

The following Paper was then read:

1. By the Rev. Professor Hincks:

"On Cell Developement."

This communication, containing some strictures on a paper on the same subject read by Professor Bovell at the previous meeting, and Professor Bovell not being present, it was ordered to be transmitted to him for the purpose of affording him an opportunity of further discussing the subject.

FOURTH ORDINARY MEETING.—17*th January*, 1857.

The Hon. Chief Justice DRAPER, C.B., President, in the Chair.

The following Gentlemen were elected Members:

ROBERT P. CROOKS, Esq., Toronto.
T. C. WALLBRIDGE, Esq., Belleville.
JAMES JOS. WOODHOUSE, Esq.,
WILLIAM ANDERSON, Esq., Toronto.
EDWARD HURD, Esq., Toronto.
AUGUSTUS HEWARD, Esq., Montreal.
EDWARD D. ASHE, Esq., R. N., F.R.A.S., Quebec.
JOHN CRICKMORE, Esq., Toronto.
WILLIAM HAMILTON, Esq., Toronto.

The following Papers were then read:

1. By Col. Baron de Rottenburg:
"Observations on the General Telescopic aspect of the Five Primary Planets, including the Planet Mercury."
2. By JOHN LANGTON, Esq., M, A.:
"On a Small Wave hitherto undescribed."
3. By Prof. D. WILSON, LL.D.:
"On the Mediæval Pageant of the Dance of Death."

Professor Wilson called the attention of the Institute to the great loss sustained by the scientific world in the late painful death of the distinguished Geologist, Hugh Miller. He bore a gratifying testimony to the character and personal worth of the deceased Geologist, and to his earnest and self-sacrificing devotion to the science with which his name will ever be honorably associated, and in the too ardent pursuit of which his life has been made a sacrifice.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—DECEMBER, 1856.

Latitude—43 *deg.* 39.4 *min. North. Longitude*—79 *deg.* 21 *min. West. Elevation above Lake Ontario,* 108 *feet.*

Day.	Barom. at temp. of 32°.				Temp of the Air.				Mean Temp. +or— of the Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN	6 A.M	2 P.M	10PM	ME'N		6 A.M	2 P.M	10 P.M	M'N	6 A.M	2 P.M	10 P.M	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M	2 P.M	10PM	Re-sul't.	ME'N		
1	29.842	29.748	29.714	29.7652	27.8°	33.7°	26.6°	28.57°	— 2.22°	.134	.154	.113	.130	.88	.79	.79	.81	N E	E b N	N	N 23° E	7.6	6.0	6.0	5.25	6.57	...	1.0
2	.683	.530	.300	.5112	28.9	27.1	26.2	26.72	— 3.77	.125	.114	.138	.122	.78	.76	.96	.83	N W b N	N b E	E N E	N 52 E	12.0	11.6	23.6	14.48	17.60	...	5.8
3	28 740	28.857	29.078	28.9098	35.6	29.5	27.7	30.43	+ 0.35	.187	.102	.132	.139	.90	.62	.86	.79	E b N	W b S	W	S 79 W	32.8	25.0	17.5	16.56	21.01	Inap	0.2
4	29.450	29.607	.732	29.6158	21.0	29.4	28.0	26.55	— 3.23	.112	.133	.114	.113	.96	.81	.74	.78	W b N	W b N	W S W	N 76 W	11.1	17.3	8.8	10.25	10.91	...	Inap
5	.791	.783	.842	.8178	26.0	29.7	20.8	24.93	— 4.43	.124	.122	.084	.104	.87	.73	.72	.75	W	W b S	S W b W	S 66 W	9.5	10.5	7.4	9.33	9.66	...	...
6	.822	.803	.800	.8142	21.0	28.5	21.5	23.45	— 5.62	.099	.109	.101	.100	.85	.69	.84	.78	W S W	W S W	W S W	S 71 W	16.4	20.2	11.5	14.27	14.28	...	...
7	.825	.765	—	—	22.8	27.6	—	—	—	.117	.131	—	—	.92	.86	—	—	W b S	W S W	W S W	S 77 W	12.3	8 8	6.8	6.95	8.11	...	0.3
8	.814	.849	.949	.8842	17.6	23.8	20.5	20.40	— 8.07	.088	.101	.105	.096	.86	.76	.91	.83	N	N W	W b N	N 48 W	6.2	2.0	6.8	3.77	4.18	...	0.1
9	30.076	30.138	30.164	30.1285	20.5	28.2	28.2	25.73	— 2.42	.098	.125	.121	.115	.86	.80	.77	.81	N N W	E S E	S S E	S 56 E	3.8	0.5	9.5	3.21	4.42	...	...
10	30.072	29.920	29.713	29.8820	28.7	33.7	35.0	31.47	+ 3.57	.146	.133	.142	.135	.92	.69	.70	.76	S E b E	E	E b S	S 82 E	4.2	7.8	7.5	6.78	7.41	0.330	...
11	29.382	.087	219	.2292	34.5	41.2	38.1	37.80	+10.15	.195	.232	.205	.206	.98	.90	.90	.91	E	S b W	S W b W	S 33 W	12.5	15.5	20.5	11.13	18.57	0.855	...
12	.439	.513	.643	.5480	34.1	34.9	29.2	33.38	+ 6.03	.139	.146	.139	.145	.71	.72	.86	.76	S W b W	S W b W	W S W	S 55 W	13.0	9.4	5.5	10.46	10.62	...	Inap
13	.842	.828	.583	.7315	32.1	35.2	34.7	34.05	+ 6.90	.164	.167	.146	.155	.91	.82	.73	.80	S W b W	S W	E b N	S 56 E	9.5	3.0	13.5	4.44	9.91	...	2.6
14	28.973	28.512	—	—	33.2	35.2	—	—	—	.189	.167	—	—	1.00	.82	—	—	E	S W b S	W b S	S 70 W	17.4	27.0	37.0	19.76	28.06	0.465	0.4
15	29.375	29.648	.745	.6155	19.7	19.5	20.0	19.35	— 7.42	.078	.077	.086	.083	.71	.71	.77	.76	W b S	N W b N	W b S	N 75 W	26.8	12.4	7.0	8.87	9.67	...	0.1
16	.741	.682	.770	.7400	19.0	21.9	14.9	18.00	— 8.57	.095	.086	.066	.080	.90	.70	.73	.76	S W b W	W b S	N W b N	N 81 W	4.5	16.2	16.0	7.64	10.20	...	0.3
17	.972	30.054	30.204	30.0972	7.2	5.3	-1.1	3.45	—22.92	.057	.050	.035	.048	.87	.83	.76	.84	N b W	N N W	N b W	N 15 W	7.7	13.6	8.3	8.17	8.27	...	Inap
18	30.414	30.436	30.383	30.4187	-8.8	-1.6	2.7	-2.08	—28.25	.022	.038	.052	.040	.67	.88	.95	.86	N	N E b N	N N E	N 52 E	4.6	5.1	9.2	7.41	9.77	...	1.0
19	30.205	29.906	29.553	29.8553	15.4	23.3	29.8	24.00	— 2.07	.087	.093	.148	.112	.93	.72	.89	.82	E	E b S	E S E	S 67 E	18.8	13.0	12.0	13.82	14.72	0.080	0.2
20	29.285	.251	.598	.3918	37.7	35.2	18.0	29.85	+ 3.97	.206	.199	.077	.153	.91	.97	.75	.85	S	W b S	W S W	S 59 W	13.0	15.4	31.0	19.02	19.96	0.060	Inap
21	.758	.771	—	—	13.7	23.3	—	—	—	.065	.085	—	—	.76	.66	—	—	S W b W	S W b S	W N W	S 48 W	18.2	8.5	3.8	10.19	11.87	...	Inap
22	519	.391	.562	.4922	19.4	21.7	16.0	18.45	— 7.22	.092	.119	.081	.095	.84	.98	.85	.89	S S E	S S E	N W b N	N 75 E	12.0	12.5	6.0	1.07	8.18	...	3.0
23	.701	.773	.810	.7785	5.0	12.2	6.8	8.37	—17.20	.043	.070	.056	.057	.73	.86	.87	.83	N W	N W b N	N W	N 33 W	4.8	14.4	12.0	9.21	9.38	...	...
24	.715	.529	.444	.5518	6.9	17.4	14.4	13.12	—12.37	.058	.073	.079	.070	.89	.73	.89	.83	N W b W	N W b W	W N W	N 62 W	10.0	16.8	18.0	16.19	16.34	...	...
25	.433	.477	—	—	17.2	21.9	—	—	—	.085	.107	—	—	.85	.88	—	—	W b N	W b N	S W b W	S 79 W	12.2	30.0	15.0	15.13	15.78	Inap	0.1
26	.593	.635	.755	.6775	23.5	28.7	24.8	25.60	+ 0.30	.110	.143	121	.122	.84	.90	.88	.87	S W b W	W	N b E	N 85 W	11.6	20.6	14.4	10.49	14.47	Inap	Inap
27	.849	.825	.745	.8010	14.9	23.2	18.7	19.03	— 6.25	.079	.105	.096	.094	.88	.81	.91	.87	N W	N b E	N E b N	N 7 E	10.6	5.5	5.0	8.37	9.42	...	0.5
28	.522	.427	—	—	22.3	26.6	—	—	—	.121	.134	—	—	.98	.91	—	—	N E b E	N E b E	W S W	S 62 W	10.5	5.6	12.5	2.27	10.49	Inap	0.1
29	.524	.614	.690	.6218	28.4	26.6	24.4	26.33	+ 1.13	.136	.123	.113	.123	.87	.83	84	.84	W S W	S W b W	W b S	S 62 W	12.0	11.0	7.0	8.55	8.70	...	Inap
30	.723	.707	.742	.7300	23.9	25.7	22.8	24.13	— 1.03	.124	.106	.109	.113	.95	.75	.86	.85	W	W S W	N W b W	S 78 W	3.4	2.0	3.4	2.96	3.13	...	0.6
31	.839	.891	.915	.8858	20.5	25.1	25.7	23.92	— 1.27	.111	.121	.119	.117	.96	.87	.85	.89	W S W	N W	N b E	N	2.0	5.0	7.5	5.22	6.70	...	Inap
M	29.7080	29.6937	29.7174	29.7113	21.56	25.35	22.09	22.88	— 4.21	.112	.117	.107	.110	.86	.79	.83	.82					11.94	12.01	11.32		11.56	1.790	16.3

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR DECEMBER.

Highest Barometer	30.480 at 10.30 a. m. on 18th	Monthly range=
Lowest Barometer	28.459 at 11.40 a. m. on 14th	2·021 inches.

Self-registering Ther.

Maximum temperature	42°2 on p. m. of 11th	Monthly range=
Minimum temperature	—9°1 on a. m. of 18th	51°3
Mean maximum temperature . .	28°74	Mean daily range = 13°19
Mean minimum temperature . .	15°55	
Greatest daily range	25°5 from a. m. of 20th to a. m. of 21st.	
Least daily range	3°3 from a. m. of 15th to a. m. of 16th.	

Warmest day . . . 11th ... Mean Temperature . . .	37°80	Difference=39°88.
Coldest day . . . . 18th ... Mean Temperature . . .	2°08	

Maximum. Solar	52°0 on p. m. of 4th	Monthly range=
Radiation. Terrestrial	—18°5 on a. m. of 18th	70°5

Aurora observed on 1 night, viz.: 23rd; possible to see Aurora on 11 nights; impossible to see Aurora on 20 nights.

Snowing on 20 days; depth, 16.3 inches; duration of fall, 62.0 hours.

Raining on 3 days; depth, 1.790 inches; duration of fall, 21.3 hours.

Mean of cloudiness=0.73; most cloudy hour observed, 6 a. m., mean=0.82: least cloudy hour observed, 10 p. m.; mean=0.67.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
2003.57	2160.36	1664 69	5094.20

Resultant direction of the wind, S 87° W; Resultant Velocity, 4.62 miles per hour.

Mean velocity of the wind 11.56 miles per hour.
Maximum velocity . . . 41.4 miles per hour, from 11 p. m. to midnight on 14th.

Most windy day . . . . 14th—Mean velocity, 28.06 miles per hour.
Least windy day . . . . 30th—Mean velocity, 3.13 do

Most windy hour	Midnight to 1 a. m—Mean velocity, 12·81 do	Difference
Least windy hour	7 to 8 a. m.—Mean velocity, 9.92 do	2.89 miles.

No Thunder or Lightning recorded this month.
7th. Large and perfect Halo round the Moon at 9 p. m
8th. Toronto Bay frozen over. Skaters and Pedestrians crossing.
" Halo round the Moon from 7 p. m.
9th. Halo and Corona round the Moon from 10 to 11 p. m.
10th. Very perfect Halo round the Moon from 9 p. m.
14th. The most windy day yet recorded at the Observatory.
18th. The coldest day in December yet recorded.
23rd. Faint Aurora at midnight,

The Barometric range for this month (2.021 inches) is the greatest yet recorded at the Observatory. A very remarkable range within 12 hours (1.014 inches) occurred from midnight of the 13th to noon of the 14th.

The Rain and Snow were both in excess of the average; the former by 0.251 inches, and the latter by 1.9 inches.

Wind. This was the most windy December since the commencement of the series, giving a mean velocity of 3.85 miles above the average of 9 years.

The resultant direction and velocity for December from 1848 to 1856, was N 75° W 2.88 miles per hour.

COMPARATIVE TABLE FOR DECEMBER.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	No. of days.	Inches.	No. of days.	Inches.	Resultant. Direction.	Resultant. Velocity.	Mean Velocity
	°	°	°	°	°					°		
1840	24.3	— 1.7	41.0	— 4.4	45.4	3	Inap	18	not recorded.	—	—	—
1841	28.7	+ 2.7	45.5	+ 2.4	43.1	7	6.600	5		—	—	1.33 lbs.
1842	24.7	— 1.3	40.3	+ 3.8	36 5	3	0.880	17		—	—	0.61 "
1843	30.0	+ 4.0	41.1	+ 2.7	38.4	6	1.040	8	8.1	—	—	0.53 "
1844	28.2	+ 2.2	48.9	— 0.8	49.7	6	Impft	6	4.2	—	—	0.40 "
1845	21.1	— 4.9	37.6	— 2.7	40.3	2	Inap	12	4.7	—	—	0.70 "
1846	27.5	+ 1.5	49.2	+ 3.7	45.5	5	1.215	9	6.0	—	—	0.57 "
1847	30.1	+ 4.1	50.0	+ 6.6	43.4	7	1.185	8	6.8	—	—	0.35 "
1848	29.1	+ 3.1	49.1	+ 0.6	48.5	7	2.750	7	16.5	s 83 w	1.04	5·44 mls.
1849	26.5	+ 0.5	41.3	— 5.2	46.5	5	0.840	12	9.6	N 82 W	2.56	6.23 "
1850	21.7	— 4.3	48.3	— 9.7	58.0	2	0.190	18	29.5	N 44 W	2.93	7.40 "
1851	21.5	— 4.5	43.8	—10.5	54.3	6	1.075	15	10.7	N 82 W	4.00	7.37 "
1852	31.9	+ 5.9	51.0	+13.9	37.1	7	3.995	10	20.1	s 69 W	1.02	6.54 "
1853	25.3	— 0.7	42.2	— 5.2	47.4	4	0.625	13	22.3	N 38 W	2.41	4.98 "
1854	21.9	— 4.1	41.8	— 5.9	47.7	5	0.590	12	17.2	N 47 W	4.18	8.66 "
1855	27.0	+ 1.0	45.9	— 2.1	48.0	6	1.845	10	29.5	s 88 w	5.33	11.38 "
1856	22.9	— 3.1	41.2	— 9.1	50.3	6	1.790	20	16.3	s 87 W	4.62	11.56 "
Mean	26.02	...	44.60	—1.29	45.89	5.1	1.539	11.7	14.4	—	—	7.73

MONTHLY METEOROLOGICAL REGISTER AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—JANUARY, 1857.

Latitude—43 *deg.* 39.4 *min. North. Longitude*—79 *deg.* 21 *min. West. Elevation above Lake Ontario,* 108 *feet.*

Day.	Barom. at temp. of 32°.				Temp· of the Air.				Mean Temp. + or — of the Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resul't. Direc. tion.	Direction of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M	2 P.M	10PM	ME'N		6 A.M	2 P.M	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A. M.	2 P. M.	10 P. M.		6 AM.	2 PM.	10 P.M.	Re-sult'.	ME'N		
1	29.964	29.961	29.971	29.9627	24.4	26.6	22.8	24.37	− 0.85	.122	.134	.120	.124	.91	.91	.94	.92	N E b N	E N E	N N E	N 37 E	9.8	6.7	8.5	8.06	8.31	...	...
2	.842	.673	.461	.6350	22.6	30.3	31.0	28.92	+ 3.72	119	139	165	145	94	82	95	89	N E b N	E	S E	S 57 E	10.0	7.0	8.0	9.23	10.86	Inap	3.5
3	.235	.239	.542	.3555	30.5	30.5	26.7	28.77	+ 3.62	167	141	111	138	98	82	76	87	S S W	S W b W	N W b W	N 80 W	17.5	10.6	12.8	11.41	14.08	...	0.3
4	.708	.783	—	—	22.8	23.7	—	—	—	107	122	—	—	85	94	—	—	W b N	N W b W	W b N	N 74 W	11.3	15.2	5.0	10.12	10.37	...	Inap
5	.893	.859	.967	.9135	14.7	16.4	4.7	10.33	−14.80	085	075	052	066	95	78	87	85	N W b N	N N W	N W b N	N 19 W	5.4	8.8	5.0	7.65	7 79	...	...
6	30.059	30.055	30.034	30.0495	−7.4	5.4	6.3	1.42	−23.72	024	049	054	043	67	81	85	80	N N W	W N W	W	N 56 W	4.6	7.7	2.0	5.20	5.39	...	...
7	29.918	29.861	30.017	29.9422	4.8	9.0	−8.4	1.00	−24.13	055	047	025	042	92	65	78	81	N N W	N b W	N N W	N 63 W	2.7	21.6	19.2	12.85	13.64	...	0.2
8	30.147	30.109	30.002	30.0705	−11.1	4.7	6 3	0.42	−24.72	025	046	056	044	86	79	90	87	W b N	W S W	W b S	S 75 W	6.0	5.8	3.0	5.51	7.15	...	...
9	29.739	29.596	29.487	29.5933	12.2	19.0	19.8	17.08	− 8.05	076	090	099	088	94	84	90	88	W S W	S W b W	S W	S 58 W	9.0	16.1	15.2	13.80	13.86	...	...
10	.311	.207	.323	.2805	18.1	22.0	22.0	20.38	− 4.67	097	114	108	105	94	94	88	92	W S W	W S W	N b W	N 13 W	3.9	3.0	6.5	7.43	8.17	...	5.5
11	.550	.713	—	—	7.0	7.9	—	—	—	060	054	—	—	92	81	—	—	N b W	N W b N	W N W	N 41 W	24.8	21.0	1.5	12.77	13.66	...	...
12	.871	.777	.695	.7783	8.8	15.4	15.8	13.37	−11.72	063	077	088	077	90	84	93	90	W b S	S W b W	S W b W	S 62 W	5.8	16.0	13.5	10.45	10.52	...	...
13	.604	.487	.529	.5357	13.6	22.1	20.5	18.40	− 6.68	080	103	108	096	93	84	95	90	W b S	S W b W	W S W	S 71 W	3.2	10.4	3.2	6.65	6.78	...	0.2
14	.484	.475	.619	.5393	18.9	19.4	10.0	15.42	− 9.68	104	093	056	082	97	85	77	86	W N W	N b W	N W b N	N 16 W	0.2	10.8	13.0	9.32	9.38	...	0.9
15	.808	.967	30.080	.9308	−3.0	6.4	4.3	2.32	−22.78	038	052	052	046	90	81	90	86	N N W	W b N	W	N 54 W	5.7	9.3	3.5	5.35	6.30	...	...
16	30.028	.741	29.541	.7453	5.7	16.4	18.7	13.53	−11.47	053	091	096	081	85	93	91	92	W S W	S W	S W b W	S 58 W	8.2	15.9	15.0	14.42	15.08	...	0.3
17	29.547	.805	30.079	.8358	17.6	3.2	−12.8	1.60	−23.42	096	038	027	048	95	70	100	83	W	N W	N b W	N 36 W	18.0	28.8	4.6	13.38	14.78	...	0.1
18	30.130	30.101	—	—	−17.8	−2.3	—	—	—	018	036	—	—	90	84	—	—	N	N	N	N 4 W	11.0	11.6	10.9	9.47	9.59	...	...
19	29.833	29.616	29.549	.6645	−3.0	15.1	15.4	9.78	−15.10	038	086	088	072	91	93	95	93	N	N W b W	N b W	N 38 W	15.0	14.2	7.3	9.32	10.37	...	0.2
20	.587	.429	.309	.4310	13.1	16.2	19.1	16.43	− 8.42	073	080	096	084	86	84	90	86	W b N	S S W	S W	S 38 W	6.9	15.2	15.0	14.18	14.69	...	1.0
21	.268	.425	.624	.4633	22.0	16.2	5.7	13.72	−11.07	111	086	053	078	91	90	85	86	W S W	W	N b W	N 83 W	10.2	20.2	7.2	13.66	15.87	...	Inap
22	.712	.717	.756	.7337	−12.8	−12.2	14.6	14.38	−39.22	026	027	023	025	96	96	96	98	N N W	N N W	N N W	N 22 W	6.8	19.6	2.0	9.93	10.22	...	...
23	.746	.847	.856	.8218	−16.2	−6.2	−7.7	−9.18	−33.85	020	026	032	028	91	71	94	87	N b E	W b N	N b W	N 69 W	14.5	0.2	0.2	4.28	6.71	...	...
24	.734	.566	.749	.6898	6.1	9.3	1.4	5.07	−19.50	055	062	051	054	87	87	100	91	S W	S W	W S W	S 52 W	16.4	22.4	2.2	12.81	13.80	...	0.2
25	.887	30.054	—	—	−4.4	10.9	—	—	—	038	059	—	—	97	77	—	—	W	W b N	W b S	N 87 W	7.2	20.0	3.0	9.31	9.63	...	0.2
26	30.151	29.864	.604	.8437	2.8	16.5	28.8	16.82	− 7.67	052	089	152	101	95	92	96	94	W	S E b S	Calm	S 21 E	0.4	7.5	0.0	3.20	3.70	Inap	Inap
27	29.566	.898	30.125	.8850	33.5	29.9	16.5	25.27	+ 0.92	191	135	079	131	100	81	82	89	S W	S W b W	N W b W	N 53 W	1.0	18.8	4.8	9.18	9.56	...	...
28	30.158	30.035	29.961	30.0463	6.8	24.3	19.0	16.48	− 7.82	058	111	097	089	90	83	91	88	N b E	E b S	N N E	N 27 E	7.0	5.8	5.4	4.49	5.52	...	...
29	29.888	29.873	.935	29.9043	13.3	25.9	20 6	19.27	− 4.93	082	112	099	094	96	79	86	86	N N W	S S W	N b W	N 52 W	2.5	7.0	5.2	1.36	3.12	...	...
30	.999	.953	.793	.9055	16.2	19.2	22.3	18.83	− 5.27	080	102	118	099	84	94	95	91	N b W	E	E b N	N 80 E	6.0	11.2	21.5	15.28	16.01	...	5.0
31	.454	.237	.187	.2908	27.0	32.1	27.2	28.88	+ 4.90	140	172	144	150	94	95	96	94	E	E S E	S W b W	S 10 W	24.0	6.4	24.0	6.42	14.75	Inap	4.2
M	29.7621	29.7138	29.7343	29.7362	10.34	16.04	12.64	12.75	−12.05	.079	.088	0083	.083	.91	84	.90	.89	....	....	....	....	8.87	12.74	8.01	......	10.31	Inap	21.8

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR JANUARY.

Highest Barometer........................ 30.168 at 8 a. m., on 8th } Monthly range=
Lowest Barometer .... 29.181 at 4 p. m., on 31st } 0.987

Self-regist'ing Thermom.
- Maximum Temperature..............37.°2 on a. m., of 27th } Monthly range=
- Minimum Temperature...........—20.°1 on p. m. of 22nd } 57.°3
- Mean maximum Temperature .... 19°46 } Mean daily range=
- Mean minimum Temperature .... 0°85 } 18.61
- Greatest daily range ....35°0 from a. m. of 26th to a. m. of 27th.
- Least daily range................. 5.9 from p. m. of 11th to a. m. of 12th.

Warmest day......... 2nd ... Mean temperature......... 28°92 } Difference = 43°30.
Coldest day........... 22nd ... Mean temperature...... —14.38 }

Maximum. { Solar ....44°0 on a. m. 27th } Monthly range=
Radiation. { Terrestrial........................... —30°5 on a. m. 23rd } 74°5

No auroral light observed.
Possible to see Aurora on 12 nights; impossible on 19 nights.

Snowing on 16 days.—depth 21.8 inches; duration of fall 87.8 hours.
Raining on 3 days,—depth Inapp. inches; duration of fall 6.5 hours.

Mean of cloudiness = 0.69.
Most cloudy hour observed, 8 a. m., mean = 0.74; least cloudy hour observed, 2 p. m., mean, =0.63.

Sums of the components of the Atmospheric Current, txpressed in miles,

North.	South.	East.	West.
2860.21	1619.39	897.11	4367.69

Resultant direction N. 70° W.; Resultant Velocity 4.96.
Mean velocity.......................... 10.31 miles per hour.
Maximum velocity .... 32.0 miles from 10 to 11 a, m. on the 17th.
Most windy day........................ 30th ...Mean velocity 16.01 miles per hour.
Least windy day .... 29th...Mean velocity 3.12 ditto.
Most windy hour ... 11 a. m. to noon......Mean velocity 13.63 ditto. } Difference
Least windy hour ... 10 to 11th p. m.......Mean velocity 8.11 ditto. } 5.52 miles.

5th—Corona round the moon at 8 and 9 p. m.
6th—Halo round the Moon, 7 p. m.
12th—Halo round the Moon, at midnight.
22nd—The coldest day recorded in January, only once equalled, viz, on 6th February, 1855.

This has been the coldest month yet recorded at Toronto, the temperature having been 10°.47 below the average of January for the last 18 years, and 1°7 lower than that of February, 1843, the coldest month that had been previously known.

The quantity of snow was 7.85 inches above the average of the last 15 years.

The Resultant Direction of the wind in January, from 1848 to 1857 inclusive was N 72° W, and the resultant velocity 2.78 miles.

COMPARATIVE TABLE FOR JANUARY.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range.	No. of days.	Inch's.	No. of days.	Inch's.	Resultant. Direction.	Resultant. V'y.	Mean Force or Velocity.
1840	° 17.0	° —6.2	° 40.6	° —13.8	° 54.4	4	1.395	11	Not recorded	...	...	....
1841	25.6	+2.4	41.7	— 4.1	45.8	2	2.150	14	Not recorded	...	...	0.36 lbs.
1842	27.9	+4.7	45.8	+ 1.3	44.5	5	2.170	9	Not recorded	...	...	0.78
1843	28.7	+5.5	54.4	+ 1.5	52.9	6	4.295	12	14.2	...	...	0.69
1844	20.2	—3.0	44 6	— 7.7	52.3	7	3.005	11	24.9	...	...	0.70
1845	26.5	+3.3	43.0	— 3.4	46.4	5	imper	9	22 7	...	...	0.70
1846	26.7	+3.5	41.2	+ 0.3	40.9	5	2.335	10	6.0	...	...	0.55
1847	23.3	+0.1	42.6	— 2.2	44.8	7	2.135	5	7.5	...	...	1.09
1848	28.7	+5.5	51.5	—12.0	63.5	7	2.245	8	7.1	N 82° W	2.03	5.82 miles
1849	18.5	—4.7	40.1	—15.2	55.3	4	1.175	10	9.2	N 63° W	3.76	6.71
1850	29.7	+6.5	46.3	+10.6	35.7	5	1.250	8	5.2	N 37° W	0.69	5.80
1851	25.5	+2.3	43.2	—12.8	56.0	4	1.275	10	7.8	S 77° W	3.26	7.69
1852	18.4	—4.8	37.3	— 7.0	44.3	0	0.000	19	30.9	N 68° W	3.14	7.67
1853	23.0	—0.2	40.9	— 6.6	47.5	1	0.290	6	7.5	N 27° W	2.52	6.34
1854	23.6	+0.4	45.2	— 4.3	49.5	7	1.270	11	7.5	N 78° W	2.31	6.86
1855	25.9	+2.7	48.2	— 4.7	52.9	5	0.525	13	23.3	N 80° W	1.86	7.67
1856	16.0	—7.2	33.1	—12.1	45.2	0	0.000	14	13.6	N 75° W	5.24	10.69
1857	12.8	—10.4	34.6	—20.1	54.7	3	inapp	16	21.8	N 70° W	4.96	10.31
M	23.22	...	43.02	—6.24	49.26	4.3	1.501	10.9	13.95			7·56 miles

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—DECEMBER, 1856.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL. D.

Latitude—45 deg. 32 min. North. Longitude—73 deg, 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32° Fahr.			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Velocity in miles per hour.			Mean direction of Wind.	Rain in Inches.	Snow in Inches.	WEATHER, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 PM	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 PM				6 A.M.	2 P.M.	10 P.M.
1	29.998	29.953	29.935	7.1	20.4	15 8	.060	.078	.105	.90	.60	.94	W	W by S	W S W	7.63	5.90	3.55	W 2 S	...	...	Cir. Cum. Str. 4	Cir. Str. 9.	Cir. Str. 10.
2	.745	.817	.774	18.5	31.9	19.1	.100	.135	.097	.86	.69	.77	W by S	W by S	E N E	0.12	0.12	0.00	W 2 S	...	...	Cir. Str. 8.	Str. 9.	Do. 10.
3	.246	28.992	28.970	8.5	11.0	15.1	.065	.077	.100	.91	83	.91	E N E	NE by E	NE by E	1.08	2.05	13.41	E 33 N	...	3.70	Do. 2.	Snow.	Snow.
4	29.978	29.841	29.791	10.5	11.9	11.8	.077	.080	.075	.85	.83	.82	W N W	W by N	W N W	9.75	22.84	29.11	W 23 N	...	...	Do. 8.	Cir. Str. 8.	Cir. Str. 10.
5	.916	.612	.842	10.0	18.1	10.0	.074	.099	.074	.82	.81	.82	W	W by N	W by N	16.19	10.90	0.21	W 11 N	...	...	Do. 10.	Ly Cum. 2.	Clear.
6	.886	.840	.823	8.9	24.2	19.1	.060	.135	.110	.83	.84	.88	W by S	W N W	W N W	10.10	2.15	2.80	W 11 N	...	0.14	Clear.	Clear.	Snow.
7	.934	.856	.928	7.2	14.5	9.0	.060	.083	.067	.88	.79	.90	W N W	W by S	W	7.77	10.47	3.61	W 3 N	...	...	Str. 4.	Do.	Cir. Str. 8. L. H.
8	.941	.949	30.031	1.9	15.0	11.5	.044	.073	.080	.85	.68	.83	W	W by S	W by S	0.57	0.17	3.37	W 11 S	...	...	Cir. Str. 2.	Cum. Str. 2.	Do. 8.
9	30.154	30.218	.340	6.1	15.0	10.1	.058	.074	.079	.91	.70	.88	W by S	W N W	W S W	2.85	1.67	3.86	W 11 N	...	...	Cir. [illegible] 4.	Cir. Str. 6.	Clear.
10	.389	.249	.282	0.6	17.7	5.6	.043	.088	.051	.88	.79	.79	S S W	E S E	E N E	2.40	0.00	3.42	E 20 N	...	...	Clear.	Fog.	Do.
11	29.679	29.701	29.384	8.5	32.5	38.3	.065	.197	.173	.91	.94	.70	E N E	S by E	S	5.41	7.62	11.82	S 20 E	0.300	...	Hoarfrost.	Sleet & Rain.	Cir. Str. 10.
12	.346	.432	.601	7.0	38.4	30.9	.218	.227	.171	.90	.89	.89	W S W	W S W	W S W	13.44	22.82	10.00	W 23 S	...	...	Cir. Str. 8.	Cir. Str. 8.	Do. 4.
13	.894	.957	30.135	18.0	24.5	12.5	.153	.134	.088	.88	.86	.87	NW b W	N N W	N E	5.52	2.15	2.40	N 23 W	...	..	Do. 8.	Do. 9.	Clear Zod. Lght.
14	29.593	29.000	28.720	23.1	23.6	20.3	.089	.135	.114	.89	.90	.87	E N E	E by N	S S E	7.64	15.44	13.12	E 33 N	...	5.80	Snow.	Snow.	Cir. Str. 10.
15	.313	.416	29.916	11.0	6.0	0.6	.043	.050	.043	.83	.80	.82	W by N	W N W	N W	26.90	26.80	16.40	W 13 N	...	...	Cir. Str. 6.	Clear.	Clear.
16	.945	.974	.965	–8.5	0.0	0.0	.026	.050	.046	.80	.89	.90	N N W	NE by E	NE by E	0.91	1.78	4.86	W 23 N	...	Inp	Cir. Str. 10.	Cir. Str. 10.	Snow.
17	30.081	30.012	30.392	–9.5	–7.6	–14.9	.024	.028	.021	.81	.80	.86	N E by E	NE by E	NW b W	15.40	3.21	16.97	E 33 N	...	...	Clear.	Clear.	Clear.
18	.611	.577	.748	–24.2	–10.0	–14.7	.009	.028	.023	.66	.89	.89	NW by W	W by S	W by S	6.50	5.50	4.04	W 3 S	...	...	Do.	Do.	Clear Zod. Lght.
19	.733	.518	.338	–21.4	–6 6	–5.0	.015	.034	.031	.79	.76	.82	E N E	NE by E	N E b E	0.12	2.11	7.52	E 33 N	...	...	Cir. Str. 6.	Cir. Str. 10.	Snow.
20	29.736	29.457	29.453	20.2	34.5	35.5	.107	.203	.203	.82	.91	.92	S	S	W S W	11.30	3.42	9.97	S 1 W	0.167	3.60	Snow.	Sleet & Rain.	Cr. Sr. 10, F. Au. B
21	.546	.848	30.021	26.4	19.2	5.5	.141	.103	.058	.88	.82	.90	W by N	W N W	SE by S	9.11	26.62	2.10	W 23 N	...	...	Clear.	Clear.	Clear Zod. Lght.
22	29.967	29.841	29.886	–4.5	6 9	7.5	.033	.059	.062	.84	.83	.90	E S E	NE by E	NE by E	1.41	7.73	14 93	E 33 N	...	...	Do.	Do.	Cir. Str. 10.
23	.933	.873	.891	9.0	15.8	8.9	.067	.087	.066	.90	.78	.92	N E by E	N E	N N E	14.07	12.90	3.41	N 44 E	...	...	Do.	Cir. Cm. Str. 2.	Clear Zod. Lght.
24	.906	.433	.381	–1.0	17.0	5.1	.038	.096	.051	.83	.83	.84	W N W	W by N	W N W	7.62	8.11	16.83	W 33 N	...	2.00	Cir. Str. 10.	Snow.	Snow.
25	.336	.375	.522	3.4	8.4	-5.0	.049	.058	.030	.85	.80	.81	W	W by N	W by N	16 23	12.55	12.86	W 10 N	...	...	Clear.	Cir. Str. 10.	Clear.
26	.668	.714	.791	–5.3	8.0	7.1	.031	.058	.061	.80	.68	.79	W by S	W by N	W by N	12.07	4 21	13.75	W 10 N	...	...	Cir. Str. 4.	Clear.	Do.
27	.841	.787	.936	0.0	17.5	12.5	.065	.089	.071	.84	.83	.84	W by S	S E by E	W by S	14.43	9.41	16.24	W 10 S	...	...	Do. 10.	Cir. Str. 6	Cir. Str. 10.
28	.846	.825	.762	0.0	15.0	4.2	.060	072	.051	.85	.72	.85	W by S	W by S	N W	0.82	0.16	4.20	W 10 S	...	Inp	Do.	Snow.	Clr. F. Au. Bor.
29	.686	.674	.743	0.0	24.7	21.2	.081	.124	.112	.89	.87	.90	S E by E	SE by E	W by S	23.22	0.82	4.11	E 33 S	...	0.40	Snow.	Cir. Str. 10.	Do.
30	.570	.794	.995	0.0	30.5	23.4	.063	.164	.125	.89	.88	.90	W S W	W S W	S E	4.26	0.27	0.03	W 23 S	...	...	Cir. Str. 6.	Do. 6.	Cr. Sr. 10, Dis. Lt.
31	30.033	30.059	30.103	0.0	23.4	19.6	.145	.118	.104	.91	.86	.88	E N E	N E	N N E	3.42	4.63	2.75	N 43 E	...	Inp	Do. 10.	Light Snow.	Do. 10.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—JANUARY, 1857.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Velocity in miles per hour.			Mean direction of Wind.	Rain in Inches.	Snow in Inches.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 PM	6 A.M.	2 P.M.	10 P.M	6 A.M.	2 P.M.	10 PM				6 A.M.	2 P.M.	10 P.M.
1	30.142	29.963	30.199	18.9	26.2	21.3	.091	.135	.089	.80	.83	.73	N E bye	E N E	N E b E	2.05	2.21	3.80	...	...	...	Cir. Str. 10.	Cir. Str. 10.	C. C. Str. 6.
2	.177	30.095	.003	18.2	24.2	18.5	.088	.091	.088	.72	.63	.72	S E byE	E N E	E b S	0.60	1.02	7.12	...	...	...	C. C. Str. 6.	Do. 8.	C. Str. 10.
3	29.913	29.527	29.585	18.1	25.0	21.0	.088	.125	.086	.73	.80	.64	S by E	N E b E	N E	11.95	7.03	14.26	...	...	4.10	Snow.	Snow.	Do. 10. L. H.
4	.734	.863	.921	18.6	20.3	11.2	.110	.101	.077	.85	.77	.83	W N W	W N W	N W	11.86	9.62	15.30	...	...	Inp	Cir. Str. 10.	C. Str. 2.	Do 2.
5	.921	.923	29.064	— 3.5	2.6	— 7.1	.033	.046	.028	.83	.84	.82	W N W	W by N	W b N	22.60	11.63	10.27	...	...	...	Clear.	Clear.	Clear.
6	30.052	.913	29.991	—13.9	— 3.0	— 6.5	.023	.036	.029	.98	.85	.86	W N W	W N W	W b N	19.06	13.52	14.01	...	...	...	Do.	Do.	Cir. 2.
7	29.961	.840	.942	—15.1	— 1.7	— 9.7	.019	.038	.029	.83	.81	.86	W by N	W	W N W	17.85	13.47	25.08	...	...	Inp	Cir. Str. 4.	C. C. Str. 4.	C. C. 6. L. H.
8	30.052	30.053	30.108	—14.0	— 3.5	—13.0	.016	.032	.021	.63	.70	.74	W S W	W S W	W	26.71	3.83	9.06	...	...	...	Clear.	Clear.	Clear.
9	29.800	29.607	29.604	—13.5	5.0	10.6	.023	.053	.064	.81	.80	.80	S W	N W b W	W S W	10.96	2.15	3.70	...	...	Inp	Cir. Str. 10.	Cir. Str. 10.	Cir. Str. 10.
10	.538	.506	.591	10.4	25.0	11.6	.064	.127	.075	.84	.83	.94	W by S	S S E	N E b E	1.61	0.11	6.77	...	...	Inp	Do.	Do.	Snow.
11	.712	.683	.732	2.7	6.8	— 4.8	.047	.059	.036	.84	.92	.84	N E	N W	W b N	24.25	6.00	12.40	...	...	...	Do. 10.	Do. 6.	C. C. Str. 4.
12	.907	.844	.927	— 4.2	8.5	11.0	.033	.058	.075	.84	.81	.91	W	W	W b S	6.53	19.07	12.42	...	...	...	Str. 8.	Clear.	Cir. Str. 10.
13	.718	.684	.663	11.5	21.4	18.5	.075	.115	.101	.94	.94	.91	W S W	S W	S W	14.30	9.60	2.15	...	...	Inp	Cir. Str. 10.	Snow.	Do 10.
14	.666	.794	.854	14.0	17.4	7.0	.083	.096	.054	.86	.84	.79	N W b W	N E	N E	7.81	4.91	3.05	...	...	...	Do. 10.	C. C. Str. 6.	Do. 10.
15	.906	.934	30.163	— 2.0	1.5	— 6.4	.046	.044	.034	.84	.83	.89	N	W by N	W S W	5.12	8.37	5.41	...	...	...	Do. 9.	Clear.	Clr. Zod. Lgt.
16	30.140	.926	29.756	— 8.9	15.9	11.2	.032	.081	.075	.88	.84	.90	W	S W b W	S S W	9.10	4.83	0.15	...	...	...	Do. 10.	Cir. Str. 10.	Snow.
17	29.533	.810	30.171	15.5	— 1.2	—18.5	.081	.038	.016	.86	.83	.80	W b S	N b E	N b E	8.75	18.07	12.92	...	...	0.70	Snow.	Clear.	Clr. Zod. Lgt.
18	30.431	30.400	.195	—31.8	— 5.6	—17.5	.010	.027	.017	.81	.71	.81	N W	S W b W	N E	3.50	1.15	0.03	...	...	...	Clear.	Do.	C. Str. 10.
19	29.984	29.591	29.534	—15.2	10.3	8.5	.019	.071	.065	.83	.90	.93	N E b N	N E b E	W N W	18.16	15.05	13.63	...	...	1.60	C. Str. 6.	Snow.	Snow.
20	.722	.736	.741	— 5.1	6.5	5.3	.031	.059	.059	.82	.79	.81	W N W	N W	N E	14.92	3.87	4.80	...	...	...	Clear.	C. Str. 10,	Cir. Str. 10.
21	.556	.634	.651	3.0	29.7	16.1	.049	.155	.084	.82	.90	.84	N N E	W	W	6.90	8.35	4.66	...	...	0.70	C. Str. 10.	Do. 10.	Clr. Zod. Lgt.
22	.677	.577	.817	— 3.5	— 9.0	—23.5	.036	.024	.012	.82	.78	.75	W N W	W N W	W N W	13.63	12.43	23.22	...	...	...	Cir. 4.	Light Cum.	Clr. do. do.
23	.829	.898	.913	—29.6	—21.1	—25.3	.008	.014	.011	.68	.65	.73	W N W	W N W	W S W	26.29	13.03	10.55	...	...	...	Hazy.	Do. 2.	Clr. do. do.
24	.976	.982	.944	—29.6	— 3.3	— 9.4	.008	.029	.024	.70	.68	.69	W S W	S E by S	N E b N	1.75	4.60	1.83	...	...	...	C. Str. 7.	C. Str. 10.	C. Str. 6.
25	30.054	30.144	30.329	—21.2	8.3	— 5.4	.013	.064	.031	.77	.90	.82	E b N	W S W	S S E	1.40	2.17	0.62	...	...	...	Clear.	Do. 10.	Clr. Zod. Lgt.
26	.450	.214	.029	—17.6	8.0	12.6	.019	.059	.078	.89	.87	.90	S	S E b S	S S E	7.06	2.30	11.22	...	...	...	Do.	Do.	C. Str. 10.
27	29.850	29.874	.163	12.6	27.9	20.1	.078	.147	.103	.91	.94	.89	S W	W	W S W	12.42	0.00	0.52	...	Inp	4.80	Snow.	Do. 10.	Clr. Zod. Lgt.
28	30.430	30.314	.244	9.4	27.9	18.0	.063	.147	.094	.90	.89	.85	E b N	E N E	E N E	2.82	0.20	3.32	...	...	...	Clear.	Do. 2.	Do. do. do
29	.052	29.989	.031	8.1	25.9	16.1	.065	.132	.084	.89	.87	.84	E S E	S W b W	W b N	6.32	1.08	3.12	...	...	...	C. Str. 10.	Do. 10.	Do. do. do.
30	.341	30.305	.308	1.0	11.0	— 6.0	.044	.059	.029	.86	.70	.82	N E bye	N E b E	E N E	5.53	3.77	3.80	...	...	...	Clear.	Clear.	Do. do. do.
31	.131	29.624	29.597	— 7.1	11.4	9.0	.028	.069	.067	.83	.80	.89	N E b E	N E b E	N E b E	20.21	20.10	18.10	...	...	7.20	C. St. 10.	Snow.	Cir. Str. 10.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR DECEMBER.

Barometer	Highest the 18th day	30.748
	Lowest the 14th day	28.720
	Monthly Mean	29.836
	Monthly Range	2.028
Thermometer	Highest the 12th day	35°2
	Lowest the 18th day	—24°.2
	Monthly Mean	10°45
	Monthly Range	59°4

Mean of Humidity .... .850

Greatest Intensity of the Sun's Rays .... 84°9

Lowest Point of Terrestrial Radiation .... —25°.1

Rain fell on 2 days, amounting to 0.467 inches; it was raining 17 hours and 55 minutes.

Snow fell on 9 days, amounting to 18.64 inches; it was snowing 51 hours 20 minutes.

Most prevalent wind, N E by E—1257 miles. Least prevalent wind, S W by W—7 miles.

Most windy day, the 4th day; mean miles per hour, 25.00.

Least windy day, the 2nd day; mean miles per hour, 0.36.

Most windy hour, from 3 to 4, A. M., 4th day; velocity 38.40 miles.

There were 78 hours and 40 minutes calm during the month.

There were 5 cloudless days in the month.

The total amount of miles traversed by the wind was 6628.20, which being resolved into the Four Cardinal Points, gives N 464.70 miles. S 458.50 miles, W 4387 miles, and E 1318 miles.

Aurora Borealis visible on 3 nights.

Zodiacal Light visible.

The electric state of the atmosphere has indicated very high tension. Electrometers constantly affected.

Ozone was in moderate quantity.

Distant flash of Lightning in the S. E. at 8.15 P. M. 30th day.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR JANUARY.

Barometer	Highest, the 18th day	30.431
	Lowest, the 11th	29.506
	Monthly Mean	29.915
	Monthly Range	0.925
Thermometer	Highest, the 28th day	27°.9
	Lowest, the 18th day	—31.8
	Monthly Mean	4°.05
	Monthly Range	59°.70

Greatest intensity of the Sun's Rays .... 78°.4

Lowest point of Terrestial Radiation .... —32.4

Mean of Humidity .... .849

Rain fell on 1 day. Inapp.

Snow fell on 11 days, amounting to 19.10 inches; it was snowing 64 hours 50 minutes.

The Aurora Borealis not visible.

Zodiacal Light very bright.

Lunar Haloes visible on 2 nights.

The electrical state of the Atmosphere has indicated high and constant Tension.

Ozone was in small quantity.

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NOTES OF TRAVEL IN CHINA.

BY JAMES H. MORRIS, M.A.

Read before the Canadian Institute, March 14th, 1857.

A residence of little more than three months in China would not justify me in giving expression to opinions on the polity, government, resources, or commercial interests of a country, whose limits extend over an area of 5,300,000 square miles, and whose population is equal to one-third of the human family. Nevertheless the observations of a recent visitor may not be devoid of interest, now when the peculiar circumstances of our relations with China, naturally direct an unusual amount of attention to that country. I shall accordingly confine my paper to that part of the country which has recently been the scene of the warlike operations of the British fleet, and will endeavour to give some idea of the singular people with whom it has had to contend.

During the existence of the south west monsoon, vessels bound to China by way of the "Cape of Good Hope," generally shape their course for the China Sea through the straits of Sunda; and after one has for many weeks felt the ennui consequent on a long sea voyage, the imagination is apt to paint in supernatural beauty the long anticipated scene. But there are favorite spots where nature exhibits herself decked in such charms as to defy the overcolouring of fancy, and among such are the straits of Sunda.

At the entrance to the straits between the Islands of Java and Suma-

tra, and in close proximity to Java, where various clustering isles adorn the scene, attention is specially attracted by an immense irregularly shaped island named "Princess Island," thickly studded with different kinds of trees which perfectly conceal the soil or naked rock from the view.

The sinuous coast of Java, however, presents a different appearance; craggy cliffs strike upwards, whose rugged faces bear the marks made by the lashing of the surge; high irregular hills in the distance whose sides are begirt with native plants, and whose tops taper to a point and hide themselves in the clouds; a sloping beach of easy access and overhung by outspreading branches which cast a shadow over the water, appearing to invite the stranger to it: far receding bays over whose surface are wafted on the breeze spicy odours from the home of the savage; and an array of cocoa nut trees extending for miles along the strand, and exhibiting from the tops of their slender trunks the tempting fruit: all add to the variety of the scene; while the majestic Banyan stands alone and affords a shady retreat for hundreds of Malays, who there seek amusement, comfort or repose.

Quantities of different species of fruit, consisting of mangustines, oranges, lemons, mangos, pine apples, and vegetables of many kinds; as also live representatives of the mixed inhabitants of the jungle: monkeys, moose deer, red and green parrots, mocking birds, sparrows, &c., are brought by the natives in canoes to passing vessels, and offered for sale.

Passing through this "Eden of the East" in a fortnight, our proximity to our destination was evinced by the appearance of high and naked islands, around which could be seen ill-shapen and odd rigged craft, which were soon recognized to be Chinese fishing boats. Off the "Lema Islands," among which is to be seen the conspicuous peak of Hong-Kong, vessels are boarded by a native pilot. Some of their boats carry foreign flags, (principally English and American,) and others the private flags of different mercantile houses, which are vouchers of the respectability of the parties who carry them. Their boats average about fifteen tons burthen and are seldom manned by less than four men. There is no necessity for a vessel to reduce her speed for these men, unless she is exceeding six or seven knots per hour, for they can always succeed in getting on board. They run down across the ship's bows and bring their boats near enough to the ship, to enable them to reach her chains with a long bamboo pole, by means of which they fasten on a grapple secured to the end of a long rope. This rope they pay out so as to prevent the sudden

impetus which is given to their boat from swamping her, and when she has assumed a tolerable degree of steadiness, the pilot pulls himself up along side and clambers over the sides of the vessel. He presents his credentials for inspection, which generally conclude with an averment that "the bearer is as honest as any Chinaman," and the terms for pilotage being agreed upon, which can invariably be reduced to one half the demand made, a few pieces of junk or salt beef, are thrown over into the pilot's boat, in accordance with the custom of the country, and it is then cast off. The Harbour of Hong-Kong, called Victoria harbour, at all times presents a very happy appearance; it is about five miles in length, and from one to three in width, hemmed in by islands and mountainous lands so as to resemble a small lake. Steamers of war, sloops and frigates, lie at anchor for the protection of the commerce of the countries they represent, and are among the first vessels which the observer distinguishes from the hundreds, including the native craft, each contributing to the variegated scene which the collection of flags presents. One could easily imagine that they were all lying in readiness to bombard the city, on a signal being given, for every sea-going vessel exhibits from her sides an array of mounted guns, many of which are superstitiously decorated by the Chinamen with pieces of red cloth.

The Island of Hong-Kong was ceded to Great Britain at the conclusion of the war with China by a treaty made in 1842, and though heretofore an expensive appendage to the British Crown, it is hoped that ere long it may become a valuable acquisition to her possessions east of the Cape of Good Hope.

Being a free port, vessels going to China on speculation, with or without a cargo, make Hong-Kong their place of destination, as they escape all harbor dues and other expenses which would be imposed on them were they to go to any other port. Sometimes they remain several weeks before they find a market for their commodities, or procure freight for the homeward passage, and this delay entails on them a certain expense by which the colony is benefitted.

The Island is about twenty-five miles in circumference, very mountainous, and yielding very little produce. The city of Victoria is upwards of three miles in length and some of the buildings are large and handsome. The principal public ones are the English Church, Government House and Government Buildings, the Barracks, and Club-houses, which are of granite and expensively furnished. From the commanding position which they occupy, they give the place a solid and wealthy appearance. Many private residences,

extending up the sides of the mountains as far as prudence sanctions, ornament the rear of the city. The streets are wide and well filled with Chinamen, among whom are intermingled people from every quarter of the globe. Some of the gay scarfs and variegated turbans of the Hindoos, as contrasted with the bare shoulders of the natives of the country, add much to the novelty of the picture. The buildings of the tradesmen are of wood, two stories high, the lower part being entirely open and in design reminding one of butchers' stalls. At night closely fitting shutters are put up. The rent of these places being high, if the lessee is not in good circumstances he frequently invites within his narrow limits two or three other tradesmen of different pursuits, who carry on their business independently of each other, but contribute an equal proportion towards the payment of the rent. A portrait painter, a tailor, and a shoemaker form a trio: a copper-smith, a tin-smith and an umbrella maker also affiliate; a hatter and a watchmaker, a haberdasher and a vender of ivory curiosities, and others of equally opposite pursuits, are seen working together. As many workmen are required to enable their masters to fulfil their engagements, all of whom are huddled together in this single room, which answers the purposes of workhouse, warehouse and shop: their numbers disincline a customer to go beyond the threshold, but he has such articles brought to the door as he desires to examine with the view of making a purchase.

Between the southern limits of the city and the Barracks, is a large public reserve of several acres which is much frequented by idle Chinamen, who resort thither to while away the day by gambling and sleeping. Peripatetic barbers and itinerant pastry cooks, migratory venders of medicine, and wandering booksellers, strolling fruiterers and roving conjurors, fill up the interval, and the unnatural sounds which some of them bellow forth in recommendation of their articles strike harshly on the ear of the foreigner. Passing along the general thoroughfare will be seen groups of Chinamen, some wearing long blue gowns reaching down to their feet and exhibiting from below a pair of dark cloth shoes, with paper soles of an inch in thickness. One hand is uplifted and holds between the sun and the head of the Chinaman, an open fan or out-spreading umbrella, while the other is engaged in twirling and lashing against his sides, the celebrated queue which is dearer than life itself. The hair is shaven off the head excepting on the crown, from which it is allowed to grow as long as nature will permit it, but the Chinaman above the order of coolies, (which are the lowest and most degraded class in

the Empire,) universally plaits into it heavy skeins of silk, which terminate within two or three inches of the ground. Others dressed only to such an extent as places them without the rigour of the law, and who are styled "coolies," wander about prepared to work if well paid, to steal, which they prefer doing, if an opportunity offers, or to join in any disturbance that may arise. These fellows are watched pretty closely by the police, who treat them with well merited severity when they detect them in the gratification of their unlawful cupidity. When brought before the police magistrate, he enrols them among the chain gang, who make and repair the public roads, and are thus rendered generally useful. This corps is distrbuted every morning throughout different parts of the town, each detachment being in charge of a policeman who holds a musket over one shoulder, and an open umbrella on the other.

There are several villages in Hong-Kong, and on the adjacent islands, the inhabitants being principally piratical fishermen, who, no doubt act in collusion with the more desperate outlaws who hoist the flag of their profession.

Excursions are constantly made by the police force and volunteers in Hong-Kong, against the piratical fishermen, and when prisoners are taken they are bound together by their queues and led to the prison. Sometimes they are handed over to the authorities at Canton, under whose direction they are decapitated. The population of the whole island is upwards of 45,000 ; the foreign residents, exclusive of the military, numbering about 300 persons. The floating part of the population in front of the city is large. This class of people exists throughout China, and is a separate race in itself. They are born, marry, and live out their existence, in their shell-like abodes. Many of them procure employment from foreign ships, each one while in the harbor having one or more native boats attached to her. Those generally patronized are about 18 feet in length, and carry sails made of matting. They are entirely decked over with closely fitting boards, and when a passenger presents himself, three or four in the centre of the boat are taken up to make room for his legs, the surrounding portion being neatly matted over and serving as a seat. The cabin into which the legs only are admitted, is floored and matted, the flooring being about two and a half feet from the deck ; and resting on the left side of the boat will be seen a little idol sitting in senseless state, and which the occupants of the boat never fail to worship, both in the morning and evening. Every boat throughout the Empire, no matter how small, is provided with its tutelar deity, before which are displayed joss-

sticks, wax tapers, and "chow-chow," or food, which is served up in small dishes, and consists of cold tea, and different species of fruit; but the loss of appetite which this uncomplaining favorite invariably manifests, if not a matter of wonder to its indulgent devotee, is at least an occasion of profit. Over head is a cylindrical frame-work covered with double matting, the inner one being made of straw, and the outer of split rattan. It protects the inmates of the boat from the tropical sun, or pelting rains which are very frequent.

The cooking takes place in the after part of the boat, each one being provided with a stone or earthenware portable kitchen, which rests between the decks, and is covered over in wet weather, or when the smoke becomes disagreeable to those on board.

The other parts of the boat are used as lockers, store-rooms, or sleeping apartments; in fact, the Chinamen sleep all over the boat, as often on deck as below: a Chinaman's bed consisting merely of a mat and split rattan pillow. Should the night be cold, instead of wrapping themselves up in blankets, they put on one suit of clothes over the other until they feel comfortable. It is a common sight on a chilly day to see a Chinaman with all his wardrobe on at once, and presenting a portly appearance with which nature never endowed him.

The boats carry one or two masts and large sails made of matting, both of which are lowered on deck when they cannot be used.

The oars are composed of two pieces of wood, the blade being bound to the loom by means of cords. At the upper end of the loom is a transverse piece of wood about five inches in length and one in diameter, which is used as a handle, and on which the oarsman can have a good purchase. Instead of row locks, there are pins about fifteen inches in height, generally having a slight curvature in them, and graduated by notches, from one of which a small loop of straw rope is suspended, through which the oar is thrust.

Sometimes the Chinamen sit down on the deck and pull as Europeans do, but their custom is to stand up facing the bow of the boat and work the oar from the shoulder. The women labor as hard as the men, and in nearly every boat will be observed one or more having an infant slung on to her back, which is rocked to sleep by the exertions of its mother.

The appearance of the children is disgusting. No attention is paid to their sanitary condition, and they are allowed to grow up without appreciating the detersive property of water. Their play mates are cockroaches, which although they exceed them in numbers

are less offensive in the sight of a foreigner. Their food, which is called "Chow-Chow," consists of boiled rice, sweet potatoes and greens, as also fish, with which they are generally well supplied. Boiled rice is the standing dish, and it is no uncommon sight to see one person consume amongst other things, from half a gallon to a gallon of rice at one meal. The rice is placed in a pail on the deck and surrounded by the greedy participators, each one having a bowl in his hand which he fills with rice, and when he has arranged the chop-sticks in his fingers, their application commences most vigorously. The bowl is held up to the mouth and the rice is shovelled in until nature demands an intermission of a few seconds to recover respiration. The idea which suggests itself on first seeing them, is that each is trying how much more he can consume than his neighbour, within a certain stipulated time.

Some of the occupants of the poorer description of craft, which slightly resemble the punts used in this country, or as a Chinaman would say "all same, leete more diffilent," are less fastidious in their tastes than those in better circumstances, and will eat anything that can be digested. Hourly they may be seen plucking the hair from a dead rat which has been thrown to them from a foreign ship, or there may be heard the last of what was an animal of the same tribe, singing his farewell song on the frying pan, and sending forth his savoury odour on the breeze.

A peculiar style of boat characterizes each province, though differing immaterially in internal economy; but the reader can form a fair idea of all of them from the foregoing description.

At a distance of 70 miles from Hong-Kong, in a northerly direction is the city of Canton. It lies on the north side of the Pearl River, up which the traveller is conveyed on an European steamer which plies between the two places. This river varies in width from a quarter of a mile to several miles, and though to a certain degree destitute of that natural grandeur which characterizes some of the rivers of America, it is not without its attractions.

It leads into a country where the christian is abhorred; which was five centuries ago as far in advance of European nations in the arts and civilization as they are now her superiors; which until compelled by the British bayonet, refused to recognize England or America as among the civilized countries on the globe, or to admit within her kingdom foreign officials on terms of equality; whose empire has been usurped by a Tartar tribe, the chief of which has ever had the power of nominating his successor, who styles himself the "Viceregent of Heaven upon earth," and who by establishing arbitrary laws which

are rigidly enforced, and by practising deceit, stratagem, and tyranny, governs a people naturally docile, and maintains his supremacy.

About midway between the mouth of the river and Canton, are the "Bogue Forts" which were captured by the British during the war of 1842, and which command such a range that they appear to guard the threshold of the Empire. Here the channel begins to narrow, and the hills rise to a great height on either side. Mounted batteries line the beach, and forts in design not unlike the Greek letter omega, are built in more elevated positions. They were in a state of decay when I saw them, and the few guns which looked from the embrasures were red with rust: but by recent accounts we learn that they have since been repaired, only to be destroyed by the British. At the summit of the hills are square formed watch towers of granite, from which a signal could be given to the ports below when an enemy approaches. An island situated further up the stream and at an angle of 45° with the Forts on shore, is also strongly fortified.

If nature did as much for the security of some enlightened countries as she has done for China, the science and ingenuity of the people would contribute such acquisitions to the natural strength, as would render the place impregnable.

A circumstance is related which happened at the "Bogue Forts," during the war of 1842, truly characteristic of the Chinese: but before mentioning it it is necessary to remark that in every part of China which has been visited by foreigners, the attention of the traveller is early arrested in consequence of the incessant noise which the natives keep up by the clang of gongs, the beating of drums, the shrill notes of the flute, the explosion of packages of fire crackers, and the confusion of tongues; this medley not tending in any degree to impress upon the mind of the unaccustomed hearer, the conviction that the Chinese have a predilection in favor of quiet.

Owing to the severity of the penal code, such a sight as an assault made by one Chinaman on the person of another is seldom or never seen, but disputes continually take place followed by angry countenances, rapid contortions of the body, and tirades "full of sound and fury," but "signifying nothing."

The commander of the Forts understanding that the British fleet was about to make an attack upon the garrison, sent off an officer in a boat with a letter to the British commander. The interpreter whose dialect will be noticed hereafter, translated it as follows: "These two piecie nation must makey fightie, spose that yankilish

man no put shot in he guns, Chinaman no put shot in he guns, makey noisey all same!"

At the distance of about ten miles from Canton is the village of Whampoa, where the foreign shipping lies at anchor, the cargoes of the different vessels being brought down to them from the city in native boats. The steamer passes through a long line of frame and bamboo houses built upon piles, and which are rather difficult of access when the tide is on the ebb.

Two celebrated pagodas are among the first objects of attraction, but their design and the object of their erection have been so frequently described by travellers, that further reference to them is unnecessary. The river between Whampoa and Canton is very narrow: on the opposite sides, embankments are thrown up to prevent the river from over flooding the paddy fields. The country on either side is under a high state of cultivation, and in whatever direction one chooses to look, from the mountain top to the valley below, on the face of the hills and over the plains, there cannot be seen one single foot of eligible soil which has escaped the tillage of the industrious Chinaman. The hills and mountain sides when practicable are terraced and prolific with sweet potatoes.

When near to Canton the number of native craft begins to increase in the channel, and the pilot stands in the bow of the steamer waving his hand in every direction as a warning to his countrymen to keep out of the way. Accidents occasionally happen which can only be attributed to the temerity or stupidity of the sufferer. The boatmen take their own time to retreat, and sometimes risk running across the bows of the steamer rather than to wait for a few seconds until she passes—happening every trip the steamer makes, it becomes very trying to the temper of the pilot and others belonging to her, who sometimes hurl a well directed missile at the craft which has approached within such an offensive proximity.

The appearance of Canton from the river is very unprepossessing, the foreign factories, the only buildings of any importance having been recently destroyed by fire. While they stood, with the beautiful gardens in front of them, over which were flying the different foreign flags, there was an aspect of comfort characterising at least a portion of the suburbs of the city which existed not within the walls.

No steeples nor domes rise up in the distance, no sloping hills crowned with solid edifices adorn the prospect, no smiling grounds surrounding a happy looking abode lie on the water side, no wide-stretching avenue opens to the view the heart of the city, no wharves

nor esplanades, but one gloomy plain of dark and decaying roofs fills up the space between the river and the mountains. A few forts not meriting a description, a couple of pagodas not particularly elegant, an occasional group of trees, and official poles standing before the residences of a mandarain, and which an author has likened to "dismantled gallows," can be seen from an eminence, but their variety gives but little relief to the sombreness of the picture.

The foreign merchants, (by which I mean the British, French and American,) were confined to a few acres of ground on the river side, which were tastefully laid out and filled with different species of trees and plants.

About one hundred yards from the water were the Hongs, or Factories in which they reside and transact their business. These buildings were three stories high, and presented a long frontage filling up latitudinally the prescribed limits. They extended some distance in depth, it being customary in China to build houses of this description in rear of each other, all being accessible by means of an arched passage which runs underneath them. Between each building, in the rear, was an area of a few feet square. These houses appeared as if built beneath a common roof; it was impossible to avoid the unwilling gaze of a neighbour into the opposite bed room, kitchen or dining room, unless by closing the blinds which would have impeded the free circulation of the air, and have made the matter worse.

The hospitality which strangers receive from foreigners throughout China is proverbial, as all travellers in the country can testify: while in addition to this their acts of generosity to strangers in distress lead one to believe that the old-fashioned virtues of charity and benevolence are not yet extinct, but exist in patriarchial simplicity wherever they are most needed.

In the foreign gardens was a neat Episcopalian Church, a Club House, and a collection of boats equal to those in any other part of the world. The city proper is surrounded by a high wall, within which no foreigner is admitted. The gates are thrown open during the day, and through the archway, a glimpse can be had of the prohibited city. After once passing through a Chinese street there are no inducements to go a second time. There are two in the neighbourhood of the factories occupied by the foreigners, from which strangers usually make their purchases. These are about ten feet in width, and are always crowded with men and women, some having boxes of tea suspended from either end of a bamboo staff which rests on the shoulders; others packages of paper similarly carried.

Starved looking cats, whose melancholy mew betokens their impending fate, are carefully secured in cages, and puppies whose keepers hold them up to the view, are ready for the dainty epicure. Expatiating booksellers, apothecaries vending their drugs to their hypocondriacal customers, and trained birds whose feats astonish the rabble, fill up the interval. This confused mass must be buffetted with, in attempting to pass through a street in Canton.

Signs innummerable, projected from one to three feet from the front of the houses, and suspended lengthwise, are adorned with gaily painted characters, which tell the name of the merchant before whose door they hang. The shops are rather dark inside, but many of them are filled with an excellent assortment of silks, ivory wares, Chinese devices, and foreign importations. The plausibility and naivette of the merchants, and in fact of every Chinaman with whom the stranger comes into contact, are very apt to achieve the purpose for which they are assumed, unless he has been previously fortified against them by one whose experience has been dearly purchased, and who wishes to save a friend from the imposition which would be practised upon him. They are an artful and untruthful race, who by smiles and complimentary addresses invite the passing stranger beneath their roof that they may rob him. They hesitate not to tell an untruth, and blush not at being detected, and the oldest foreign residents in China, freely say that the more respectable the appearance of the man, or exalted his position among his fellow men, the greater is the necessity for doubting his sincerity. No moral principle regulates their action in life, interest alone compels them to perform their agreements with the foreign residents, having been taught that they will not be patronized unless they are upright in their dealings with them. They ask the stranger five times as much for an article as they would be ultimately willing to take for it.

The shopmen, and in fact, nearly all the tankia or boat people in the neighborhood of the foreign gardens, speak a corruption of the English language, commonly called "pigeon English," *pigeon* being the Chinese mode of pronouncing "business."

This language has become a regular dialect, and when first heard by the stranger it would appear as though the person speaking was parading indiscriminately, a few English words before his hearer whose duty it was to make a meaning out of them. A foreign resident will introduce a friend to a Chinese merchant as follows: "mi chin-chin you, this one velly good flin belong mi, mi wantchie you do plopel pigeon along he all same fashion along mi—spose no do plopel

pigeon, mi flin cum down side mi housie, talke mi so fashion mi kick up bobbery along you." To which the Chinaman will reply: "mi savey no casion makey flaid, can secure do plopel pigeon long you flin all same fashin long you."

Fighting with crickets is a common amusement among the Chinese, and the belligerents can be purchased in small cages. A foreigner wishing to ask for a cricket will say: "mi wantchie makey look, see those two pieces ting makey fightie."—"Haiyah hab got can catechie chop-chop," will be the Chinaman's reply.

This language is as simple as it is absurd, but the words must be arranged as the Chinaman has been accustomed to hear them, or he will not understand what is said. It is spoken in all the ports of China open to foreign trade, and there is no disposition to adopt a purer one. No matter how fluently the China merchant may speak this "pigeon English," he cannot understand anything that is spoken among the foreigners themselves; and this is on the whole fortunate, as remarks are daily made at table about the country and its institutions, which would not be at all gratifying to a mandarin to hear.

The majority of the streets are very narrow, and it would not be a difficult matter for a person to get by one single step from one side to the other. Most of the retired streets are occupied by tradesmen, those of a similar calling keeping together and occupying a whole side of a street. A long row of houses solely occupied by shoemakers, will be seen on one side, and on the other side an equal number of tailoring establishments or trunk makers, all of whom are hard at work. One would fancy that it would be to the interest of all parties were they to distribute themselves throughout the city, but it is to be inferred that they each have patrons who find out their favorite link in the long chain, and visit no other. In many of the streets are to be seen shops containing goods of foreign manufacture, and there are many other indications of the benefits which the Chinese are deriving from foreign intercourse. Ugly looking implements of torture standing in racks, and under the custody of policemen, occupy a position in every street, their disreputable guardians being a greater source of dread to the people than the polished steel itself. The police are poorly paid by the Government, and make up the deficiency by practising enormities upon the people, which dare not be introduced into any civilized country. They are complained of at times by the people, but no heed is given to their petition, unless it is accompanied by a certain amount of money which the sufferer is unwilling and in most instances unable to furnish.

Licensed beggars walk the streets, some of them in a most pitiable condition. This class of the community elects a chief man, who, during his supremacy, is responsible for the misconduct of any of his subjects, and aids the government in detecting any who have infringed the laws of the Empire. They are allowed to frequent all public places and thoroughfares, and would be intolerable, were it not for a custom which exists among the respectable foreign and Chinese houses of paying a monthly sum to the head man, which exempts the donors from the importunities of the vagrants. This is the only method of evading them, and so well disciplined are they, that they seldom approach those whom they have been instructed to avoid.

It is customary amongst the Chinese to have public exhibitions in the streets, which are paid for by private subscription, and which give the people something to talk about for several days. On occasions of this kind the streets are roofed over from one end to the other, and chandeliers and gaily painted lanterns, are suspended from the rafters. Along the sides of the streets are arranged trained plants, some representing a deer and kid, others birds, pagodas, and sundry other devices, all of which indicate the ingenuity of the Chinese.

At either end of the street stages are erected, which are occupied by theatrical performers, tumblers, jugglers, and musicians: hundreds of wax tapers are lighted within the street, and on looking through it from the entrance it has a most dazzling appearance.

On crossing the river between the main land and the island of Honam, (which lies opposite the foreign factories,) at ebb tide ill-shaped looking rocks shoot up in the stream, on which will be seen groups of Chinamen washing, or rather destroying clothes. Instead of using a board or rubbing the linen between their hands, as civilized washerwomen do, these fellows twist the articles into ropes and thrash away on the pointed rocks, each blow taking more than a week's wear out of the garment. When anything requiring particular care is given to them, they beat it between two stones, which soon find their way through it, much to the displeasure of the owner.

Some of the Hongs occupied by the Chinese tea merchants, are substantial brick and stone buildings, and considering their locality, imbedded as they generally are in the centre of a densely inhabited part of the city, are airy and comfortable. They are approached by means of an archway, or warehouse, a door opening from it into the street. These places are used for the stowage of tea, which is brought down from the country. Within these

warehouses are dozens of active Chinamen busily engaged in putting matting on the boxes which are intended for exportation. At the extreme end is the Hong of the merchant, the rooms on the ground floor being used for offices and reception rooms, while those on the upper story are the private apartments of the household. Throughout the private hall up stairs are distributed tables and chairs of a very costly description, the wood work being of a dark colour similar to ebony, very massive and richly carved. On the top of each is inserted a marble slab suitable to the purpose for which it is designed.

On either side of the hall is a row of chairs and small tables alternately arranged, so that each guest when seated has a separate table to himself. A cup of tea is invariably handed to a visitor with the leaves lying in the bottom of it. The cups are very small, and the Chinese drink the infusion without using either sugar or milk. In the rear of the houses, and in some cases in front of them is a flower garden shaded by fruit-bearing trees, beneath which the wife or wives, and children of the Chinaman are permitted to walk. The female portion of the community are never visible. Canton is the capital of the province within which it lies, and being the oldest place in the empire open to foreign trade, people from all quarters of the globe are pushing their fortunes within its precincts.

The natives are treacherous towards foreigners and troublesome to the Government, and the seditious can be seen undergoing punishment in the public streets. For petty offences a man is thrashed through the streets. Men sentenced to wear the cangue, or moving pillory, often fill up the way, and their sorrowful countenances are indices of their suffering. The cangue weighs about fifty pounds, and is composed of heavy planks about four feet square, in the centre of which is a hole large enough to allow the neck to work with ease when this collar is placed on it. The prisoner is allowed to go at large, and is fed solely by the hand of charity. His name and the nature of his offence, are written on the front of the cangue. It is just wide enough to prevent him from lifting his hand to his mouth, to walk is distressing, to lie down impossible, so these poor wretches are worn out by fatigue and end their life by the way side. But the reckless indifference of the Chinese to the value of human life is well known. During the year 1855, upwards of eighty thousand heads were cut off in Canton alone.

Situated at the distance of about sixty miles from Canton in a westerly direction, is the Island of Macao, which is under the res-

pective jurisdiction of the Portuguese and Chinese Governments. Portugal has had a lease of part of the island for the past two centuries, which will continue so long as the yearly rent is paid. In former days, and during the existence of the East India Company's charter, Macao was the head quarters, in China, of that honorable body, and the improvements which they added to the place by the erection of superior buildings and the general adornment of the neighbourhood are still to be seen, but divested of their original attractions. The city lies between two hills, on a peninsula stretching forth from the island, and its breadth is only about a quarter of a mile or very little more; a current of cool air is continually circulating through it, which makes it a place of resort during the hottest months in the year. The Portuguese population is under the direction of a Governor who has a few soldiers allowed to him, to enable him to keep the place in subjection, and prevent the encroachments of the Chinese. A wall is built across the island, the Chinese Mandarin having his residence in the village on one side of it, and the Portuguese Governor his abode on the other. Each has exclusive jurisdiction over his own countrymen, and when a subject of one domain renders himself amenable to the laws of the other, he is transferred to his own Government to undergo his trial and receive his sentence if convicted. On the tops of the hills are extensive forts which perfectly guard the city from attack on any quarter. The buildings erected by the East India Company are located on the south side of the island, at a short distance from the beach, and give the place a pleasing appearance from the water. They give a frontage to the city between the hills, and form an agreeable contrast with the spires and domes which rise up in their rear. Parallel with the beach is a wide level road called the "Praya Grand," at the eastern extremity of which is a park. This is resorted to on Sunday afternoon, by the whole community, to enjoy the delightful music which the military band is generously discoursing, with a view to dispel any gloom that might have arisen during the religious exercises of the morning.

There are two Roman Catholic Churches in Macoa, and as there are no seats in either of them, the female worshippers sit down on the floor, each having brought a small woollen mat, which she throws down on the spot she has selected. The women wear gay muslin or calico dresses, and a cambric shawl which is drawn up over the head in lieu of a bonnet

Nearly all the principal foreign merchants in Canton, have furnished houses in Macao which they visit in hot weather. They are

kept up for the benefit of the young men in their employment, who after a busy season are permitted to take a few days to themselves, which can be more agreeably passed in Macao than elsewhere. So great is the variety of fish in the waters surrounding Macao, that according to the statements of old residents, there is a separate fish for every day in the year.

Since the expiration of the charter of the East India Company, Macao has been gradually declining, but she would have revived during the wsr between England and China, in 1842, had not a spirit manifested itself which defeated its own object. At that time foreigners were obliged to leave Canton, and take up their abode and transact their business on this island, and all foreign vessels resorted to its harbour. If instead of imposing heavy duties on foreign commodities, and harbour dues upon the shipping, the port had then been free, Macao would not have been obliged to transfer to Hong-Kong, the short lived distinction which circumstances involuntary granted her. Her rulers now feel the weakness of their policy, which evinces its effects in the harbour, the streets, and the buildings. Only native craft disturb her waters, the streets are desolate, and many of the India Company's Hongs are untenanted. Those merchants who have private residences at present, will not retain them after their lease expires, and thus by the short sighted policy of the governing powers of Macao, other islands are destined to outnumber her in population, and exceed her in wealth. Nevertheless, Macao must still be a place of interest to every foreigner, and sacred in the memory of Portugal. Her pure air and solitary retreats were once enjoyed by an exile, who conscious of his wrongs, still restrained the pen of calumny, and painted in immortal verse, the glory of his fatherland. The cave of Camœns, in which was composed a portion of the famous Lusiad, can be seen on this island; and when the stranger looks upon the cenotaph erected in its centre by order of the country which had exiled him,—calling to rememberance that the mighty spirit of the poet in whose honour it was tardily reared, had perished in the streets of Lisbon, driven forth by hunger, neglect and sorrow; and that no finger can point to the resting place ot Portugal's greatest hero; he loses all sympathy for the oppressor in contemplating the sufferings of the victim, and feels that this,—like so many other national tributes to genius,—is rather a memorial of the nation's shame.

ON THE EMPLOYMENT OF THE ELECTRIC TELEGRAPH FOR PREDICTING STORMS.

BY G. T. KINGSTON, M.A.,
PROFESSOR OF METEOROLOGY, UNIVERSITY COLLEGE, AND DIRECTOR OF THE MAGNETIC OBSERVATORY, TORONTO.

Read before the Canadian Institute, 24th January, 1857.

The employment of the Electric Telegraph for transmitting intelligence relative to the Meteorological conditions that prevail at the same instant, over a wide area of country, is an application so obvious, that it is not surprising that it should have occurred to the minds of many. A few years since an arrangement was in existence in England, by which Mr. Glaisher at Greenwich, received by telegraph, daily reports, at a certain hour, of the state of the wind and weather from various localities in England, Ireland, and Belgium, and there is, I believe, a similar system at the present time in operation, with its centre at the Exchange in Liverpool.

The general idea then involved in the present communication is not new ; but this circumstance, though it destroys any claim to originality, possesses at least this advantage, that members of the Institute who may be called on either to reject the following suggestions, or to co-operate in carrying them into effect, will take up the matter with minds somewhat prepared for the task, by previous experience and reflection.

Not to occupy time with further preliminary remarks, I shall proceed at once to state briefly the general nature of the scheme that I have to propose.

That the annual loss by shipwreck, of property, (not to say life,) in the American lakes is considerable, there can be no question. The Lake Association of underwriters on the American side, estimated, the loss during the season just closing as over FOUR MILLIONS OF DOLLARS ; and it will be found, I have little doubt, that the loss on the British side is proportionably great. It should be remembered further that these losses' whatever they may be, other things remaining the same, will increase with increasing commerce. I have not at command any statistics relative to the loss of shipping on the rivers and sea coasts ; nor is it essential that I should produce such ; since the general fact without precise numerical data, is a sufficient basis for that which is to follow.

There can be no question but that many shipwrecks would be prevented, if vessels in port had timely notice of a coming gale.

Ships intending to remain would make preparations requisite for withstanding it; and those about to sail would either postpone, or hasten their departure.

Admitting then that wrecks are numerous, and that their number, as well as that of many minor disasters, might be materially diminished if gales were commonly foreseen, I go on to consider the means, *first* of procuring the necessary intelligence; and *secondly* of transmitting that intelligence to the shipping.

On the latter object, the *transmission* namely of intelligence, it is not necessary to dwell, since for this purpose the ordinary machinery of the telegraph is sufficient; and I may therefore confine my attention to the object first named, that of *procuring* the information requisite for the prediction of an approaching storm.

The possibility of doing this depends on the truth of the two following statements, the first of which is certain, and the second highly probable.

1. That gales prevail in some localities often many hours, sometimes two or three days before they reach other places only a few hundred miles distant.

2. That storms in their progress are subject to definite laws, which extended observation will discover.

Assuming the object to be practicable, I propose to effect it by an arrangement of which the following is a rough sketch:

With the concurrence of the telegraph companies, the operator at each of certain specified stations in British North America, should have orders to send immediate notice to the telegraph office at Toronto, of the commencement of a gale at his station. On receiving such a message, the operator at Toronto would call the attention of the Observatory by an alarum, or other contrivance; then repeat the message and connect the observatory wires with those from the various selected stations. The Observatory would then issue orders for hourly or half-hourly returns, or make such occasional enquiries as might be thought expedient.

The information thus collected would supply the data from which to derive a knowledge of the laws that govern the progress of storms, and if these laws were understood, would enable the central office to send notice to the ports along the lake and sea coast, and the various districts through which the storm was about to pass, of the probable time of its arrival, the quarter from which it might be expected, and its approximate duration.

I do not anticipate that the expenses attending such an arrange-

ment would be heavy; but at any rate I feel certain, that if it were carried into successful operation, the expenses would be covered a thousand fold by the saving to life and property that it would occasion. To enter at present into further details, would I think be premature; I therefore leave the matter for the Institute either to take up or to reject.

REPORT OF THE COMMITTEE ON PROFESSOR KINGSTON'S PLAN FOR PREDICTING STORMS.

Read before the Canadian Institute, 14th March, 1857.

The Committee of the Council of the Canadian Institute, to whom was referred Professor Kingston's paper on the application of the Electric Telegraph, in giving intimation of storms ocurring at different localities, present the following Report:

The Committee consisted of Baron de Rottenburg, Professor Croft, and Professor Cherriman; in addition to whom they had the assistance of Professor Kingston, and of Mr. Alexander, telegraph operator.

The Committee recommend that Professor Kingston's paper be printed, and a letter be addressed, with a copy of the paper, to the several Boards of Trade and Insurance Offices in the Province, with a view of securing their co-operation in carrying out the objects the Professor has in view; and suggesting to these bodies the advisability of their entering into some agreement with the several Telegraph Companies, to defray the expenses of forwarding the necessary telegraphic messages from one station to another, and also to the magnetic observatory at Toronto; and whenever these arrangements shall be completed, that a letter be addressed to the Secretary of the Province, to obtain for the Magnetic Observatory the services of an additional assistant, as a telegraphic operator, and that authority shall also be demanded to defray the expenses of laying down wires from the observatory to the telegraph office.

The telegraph stations which appear to the Committee to be favourably situated for the transmission of notices of storms which may occur in the localities, or for forwarding such notices from other places are as follows, viz:

Halifax, N. S.,	Fredericton, N. B.,
Riviere du Loup,	Quebec,
Three Rivers,	Montreal,
Ottawa City,	Prescott,
Kingston,	Cobourg,
Toronto,	Hamilton,
Port Dalhousie,	Port Colborne,
Port Dover,	Windsor,
Sarnia,	Goderich,
Collingwood,	Barrie.

Availing themselves of the experience of Mr. Alexander, in reference to the probable expense of the necessary telegraphic messages, the Committee are led to believe that this would not exceed £200 annually; and Mr. Alexander suggests, that it would be desirable for the Insurance Companies to insert in policies of Insurance hereafter, a clause obliging captains and owners of vessels to make inquiries at stations, from which their vessels are about to sail, whether any storm is raging at the time in the direction of their course; and that if this was done, and the expenses of such messages or information were paid for by said captains or owners of vessels, it would lessen the expense.

DE ROTTENBURG, Convener.

ON AN OCCULTATION OF SPICA VIRGINIS BY THE MOON.

BY COLONEL BARON DE ROTTENBURG.

Read before the Canadian Institute, 4th April, 1857.

The following brief remarks upon the Planetary appearance of Stars of the 1st and 2nd magnitudes, on the night of the 12th March, 1857, when taken into consideration along with the accompanying notes of independent observations, on the occultation of Spica Virginis by the moon, on the morning of the 13th March, will not, I trust, be deemed unworthy of the attention of the members of the Canadian Institute. The first of these does not indeed possess in itself sufficient importance to warrant its forming the subject of

a particular communication, but when it is regarded in connection with some unusual, though not unprecedented appearances seen in the occultation of the star Spica at the same time, and it is considered that possibly the same optical or atmospheric causes may have exercised more or less influence on both phenomena, I have been induced to bring both matters before the Institute.

With reference to the planetary look of the stars, of the 1st and 2nd magnitude, as observed by me on the night of the 12th March, (a night not easily forgotten, having been that on which the terrible railroad accident occurred at the Desjardins Canal bridge,) I saw that bright star in Lyra, (Vega,) with a disc like the planet Jupiter; this was about one o'clock on the morning of the 13th. I could scarcely believe it was not a new star, so brilliant was its appearance, till I satisfied myself of its identity; I then observed the other stars of the 1st and 2nd magnitudes which were visible, viz. Arcturus, Regulus, Procyon, Castor, Pollux, and Capella; and all of these presented the same marked planetary appearance, with an absence of scintillation, and altogether different from the ordinary look of these stars. The moon was shining bright—being only two days past the full; the night was cold and frosty, but perfectly calm; the stars resembled the appearance they exhibit in the tropics as described by Humboldt, who says, referring such appearances to atmospheric causes: "thus the more equal mixture of the atmospheric strata in and near the tropics, and that faintness or total absence of scintillation of the fixed stars, when they are 12 or 15 degrees above the horizon, give the vault of heaven a peculiar character of mild effulgence and repose. Cumana and the rainless portion of the Peruvian Coast of the Pacific, were peculiarily suited for such observations; on the average, the fixed stars appear only to scintillate when less than 10 degrees above the horizon, at greater elevations they shed a mild planetary light," &c. And again Humboldt says, quoting another author's remarks, speaking of the climate of Arabia: "the light of the stars is pure, steady, and brilliant; and it is only in the middle of winter that a slight degree of scintilliation is observed." All this, however, is very different from the general look of the starry vault in Canada, where on cold and frosty nights the stars twinkle continually; and where even in summer the planetary look is *wanting*.

Some stars, however, by an inherent property in their light, twinkle more than others. Humboldt says Vega is perhaps one of the stars which twinkles the least; Arcturus and Capella also

generally shine with a very steady light—my own observations induce to the belief, that, Aldebaran is a star, of the 1st magnitude, which does not shine with as steady a light as those I have named above. Now with regard to the planetary appearance of the stars on this occasion, irradiation cannot be overlooked. It is irradiation which causes a luminous body when projected upon a dark ground to appear of increased size, and the reverse of this holds good, viz.: when a dark object is projected on a bright ground, the light encroaches on the dark body, which consequently appears diminished in size; thus the new moon with the "old moon in her arms," as it is technically expressed, shows this property of irradiation very decisively, in the projection of the luminous portion of the moon's disc, beyond the unilluminated part of the moon. Irradiation causes Venus to appear circular when the planet is in the form of a crescent: I speak in these instances of unassisted vision. The telescope under certain powers overcomes the effects of irradiation, and strips both the stars and the moon of this false light. In a transit of Venus or Mercury across the sun's disc, the true diameters of the planets are diminished by the encroachment of the luminous body of the sun. Irradiation, however, is diminished by the illumination of the ground on which a luminous body is projected. Thus, stars of the 1st magnitude appear to the naked eye of an inferior rank when seen in twilight or by moonlight; and therefore under ordinary conditions, the stars of the 1st and 2nd magnitudes seen by me on the morning of the 13th March, should have exhibited less intensity of light, and presented less appearance of irradiation in consequence of the bright moonlight, than they would have done if seen on a dark night; the reverse, however, was the case, for they not only appeared with planetary discs, (if my vision is to be trusted,) but also shone with greater brilliancy, and with a greater absence of scintillation than ordinarily. To what causes are these appearances to be ascribed?

It is well known that, when stars are viewed with the best telescopes and with high magnifying powers, they present planetary discs, with alternate dark and bright rings surrounding them, but these discs are spurious, caused it is supposed by the diffraction of light. Viewed with low powers and in the finest instruments, stars of the 1st magnitudes appear as mere points of light; and that they have no sensible discs, is proved by the instantaneous extinction of the light of a star when occulted by the moon. As the night on this occasion was frosty, and the moonlight strong; the stars according to cus-

tom should have twinkled more than on a summer night, and as I said before, should have appeared with diminished lustre.

In order to satisfy myself whether I was mistaken in my opinion, I wrote to Mr. Chalmers, F.R.A.S., who resides at Barrie, to ascertain whether he had also seen the appearance I have attemped to describe. His reply corroborates what I have said; and also introduces the subject forming the second part of this paper, viz. the occultation of Spica by the moon, which it was my intention to have observed, but which intention I was unavoidably prevented from carrying into effect. I will now submit to the Institute, that portion of Mr. Chalmer's reply which refers to the subject matter of this paper.

Mr. Chalmers says, "I did observe the planetary appearance of one star of the 1st magnitude as you describe, by mere chance. It was a very cold night, the 12th, (at least here,) but I happened to be up late, and before going to bed I had a look at the moon with the naked eye; I then saw that Spica Virginis would be occulted, and I waited up for it. I extract the notes I made at the time: 13th March, 1-2 a m., mean time, Barrie; Spica Virginis occulted by the moon, the star was actually projected on the moon's disc, as I could distinctly see the edge of our satellite outside the star; the star then disappeared instantaneously, not gradually, but as if it had been extinguished in a moment. The atmosphere was perfectly clear, with a sharp frost; the star did not appear to suffer any diminution of light, and was occulted at the bright edge of the moon;—curious planetary appearance of the star—telescope used three and a half foot, by Dollond—definition excellent. The occultation of Spica as seen at Barrie, being a subject of far greater interest than my own observations on the night in question, I shall proceed at once to offer to the notice of the Institute, some remarks made by eminent authorities on the way in which stars have been seen either to hang as it were upon the moon's disc, be projected on it, or reappear and disappear along the edge of the moon, in occultations.

Arago saw, during a total eclipse of the moon, a star distinctly adhere to the slightly luminous disc of the moon during the conjunction. Humboldt says, those cases in which it has been asserted that a disappearance and reappearance and then a repeated disappearance, have been observed during an occultation, may probably indicate the ingress to have taken place at a part of the moon's edge, which happened to be deformed by mountain declivities and deep chasms. Lardner says: some observers of sufficient weight and authority to command gene-

ral confidence, have occasionally witnessed a phenomenon in occultations, which has hitherto been unexplained. According to them it sometimes happens that after the occulted star has passed behind the limb of the moon, it continues to be seen even for a considerable time, notwithstanding the actual interposition of the body of the moon. If this be not an optical illusion, and if the vertical rays come straight to the observer, they must pass through a deep fissure in the moon.

Mr. Hind observes : some authorities adduce an argument in favor of the presence of a lunar atmosphere, from a curious appearance occasionally noticed, when the moon passes before a star—a phenomenon technically known as an occultation—it most frequently happens that the star disappears instantaneously in coming in contact with the moon's limb, and reappears as suddenly and completely, when emerging from behind her disc. But this is not invariably the case; it has been remarked that instead of vanishing entirely at the moment of contact, the star is sometimes seen projected on the moon's disc, for several seconds of time, and a similar appearance takes place, (though more rarely,) before the final emerging from the other limb. About twenty years ago, a good deal of interest was excited amongst astronomers in reference to this matter, and some occultations of the bright star Aldebaran, were closely watched at the principal European observatories. The result proved far from conclusive—at the royal observatory, Greenwich, some observers saw nothing unusual either at the immersion or emersion of Aldebaran, the star disappeared and reappeared instantaneously; others on the contrary, saw it distinctly projected on the moon's disc for a second or two, before being occulted, and these persons even observed with similar instruments, and from the same station.

Instances are on record where a star instead of disappearing finally, when first in contact with the moon's limb, has run along it and reappeared several times, evidently between the mountains on the edge of her disc. On the 7th March, 1794, Professor Koch, saw Aldebaran disappear and reappear three times, about thirty seconds or so intervening between immersion and emersion. Another observation of a similar kind was made by Mr. Rumker, at Hamburg, on the 19th February, 1820 ; a star of 7th magnitude appeared to run with extreme rapidity along the summits of the mountains in the moon's edge, by which it was eclipsed from time to time. This " magnificient spectacle" continued nearly ten minutes, when the star finally vanished.

The above remarks by very eminent observers, fully bear out the occurrence of such phenomena as recorded at Barrie, on the evening in question. To account satisfactorily for all such appearances is another matter. Mr. Hind seems disposed to refer the differences which so many practised observers have exhibited, with regard to the occultation of Aldebaran, to the instruments employed, and to the observers themselves, for a satisfactory explanation of the whole.

The question to be decided on the present occasion, is whether it is probable that the projection of Spica upon the moon's limb, as described by the observer at Barrie, is in any way connected with atmospheric or optical causes, which may have influenced the peculiar appearance of the stars on that night, or rather morning—or whether it is to be ascribed to a lunar atmosphere, to an optical illusion, or to some other cause. On these points I do not presume to offer an opinion; but leave them for the consideration of the members of the Institute, some of whom may be able to give a more satisfactory reply than I can. In conclusion I may observe that this paper contains but a moderate amount of original matter, but if the subject is one deserving attention, the quotations from authors of repute are necessarily frequent and unavoidable for its due consideration.

REVIEWS.

Recherches sur les principes Mathématiques de la Théorie des Richesses, par Augustin Cournot, Recteur de l'Académie et Professeur de la Faculté des Sciences de Grenoble. Paris: Hachette, 1838.

"Whatever is obscure is not French," said Voltaire in allusion to the French language. Since Voltaire's day, the remark may be extended to many other developments of French intellect besides their language. In matters of pure science, whether inductive or analytical, the French justly rank foremost of the age since Newton died, but most especially do they surpass all other nations in the precision and clearness of style with which their writers are in the habit, seemingly instinctive, of presenting their subject for discussion; and in dissecting the most recondite and intricate phenomena, they handle the scalpel with an easy grace which *nos autres* are fain to admire but try to imitate in vain: whatever objections we may

make to the principles, the method, or the conclusions of a French philosopher, we may always be sure that it is our own fault if these objections are founded on a misconception of his meaning. To the French philosophers we owe almost entirely those applications of abstract science to the problems of social organisation, which are already beginning to produce important results: the calculus of probabilities, as given by Laplace, is destined to effect perhaps the greatest social changes that the world has yet seen: still, in that very wide field of research, which we call by the general name of political economy, no mathematician had hitherto ventured to intrude; yet surely no science ever called louder for this aid. Search where we will amid the labyrinth of words which at present is said to constitute our political philosophy, we shall not fail to come across definitions undefined, many-headed ambiguities of terms, confusions of consequence and hypothesis, hardy prognostications of contingencies that never happen, till the exasperated searcher resigns in despair the "talking theory," and submits, sulkily enough, to the "silent practice."

It may fairly be doubted whether our science of political economy has made one real step in advance since the famous treatise of Adam Smith; yet, admirable in itself and wonderful considering the circumstances of its production, as this treatise is, Smith has done little more than clear away obstructions and trace out the foundations of the building which is to be: materials enough were ready at hand, but tools were wanting. As in most other sciences, the first investigators are stopped by failure of modes of expression and forms of calculation; seldom has it happened that a science springs all-armed from the brain of one man as of Newton; yet if Archimedes had possessed the Arabic numerals and the Hindoo algebra, the world would not have waited two thousand years for a Newton; and if Adam Smith had possessed the calculus, we should not at this day be wearied and perplexed with the prolix circumlocution of Ricard, or the refining complications of Mill.

The work cited at the head of this article is the first attempt that we are aware of to submit any part of this subject to formal analysis. Its author is a well known and able French mathematician, and his work is no less remarkable for the novelty of its method and the lucidity of its style, than for the nature of the results which he has obtained, and for which he justly claims the character of scientific deductions. We do not propose in this place to examine the truth of the principles from which he sets out: all that we contend for is that, granting the principles, the conclusions follow inevitably. As the

work has never been translated into English, so far as we are aware, our object will merely be at present to give an outline of the system followed and some of the deduced consequences, paraphrasing, as nearly as may be, the statements of the author himself, and for this purpose we shall let him introduce the "theory of riches," in his own words:

> One cannot conceive that men can live any length of time in connection with one another, without practising the exchange of property or services, but there is a wide step between this natural, and, so to speak, instinctive act, and the abstract idea of a *value of exchange* which supposes that the objects to which we assign such a value are *dans le commerce*; that is to say, that we are always able to exchange them for objects of equal value. However, the things to which the condition of commercial relations and civil institutions permit us thus to assign such a value are those which in actual language, we commonly design by the word "riches;" and for the purposes of our theory, we shall identify absolutely the meaning of the word "riches" with that presented by the words "exchangeable values" * * * * * We must distinguish well between the abstract idea of "riches" or "exchangeable values," (an idea fixed, and in consequence capable of lending itself to rigorous combinations,) from the accessory ideas of utility, rarity, adaptation to the wants or enjoyments of man, which the term "riches" in ordinary language recalls; these ideas are by nature variable and indeterminate, and no scientific theory can be founded on them. The division of economists into sects, and the war carried on between practical men and theorists, arise in great part only from the ambiguity of the word "riches" in common language, and the confusion which has always prevailed between the fixed, determinate, idea of "exchangeable value," and those of "utility" which every one can estimate in his own fashion, because there is no fixed standard of measure to which reference is possible. * * * * *
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> We must also distinguish between the *relative* changes of value, which are exhibited by the variation of the relative values, from the *absolute* changes of value of one or other of the commodities between which exchange has established relations. * * In our theory, there exist only *relative* values: to seek for others is to contradict the notion itself of "exchangeable value," which implies necessarily that of a relation between two terms. Moreover, the change effected in such a relation is a relative effect which can and ought to be explained by absolute changes in the terms of this relation. There are no such things as absolute values, but there are certainly absolute movements of rise and fall in values, and the knowledge of the laws which regulate these constitutes the "theory of riches."

Having thus precisely defined the object of his researches, Cournot devotes a chapter or two to the consideration of "money," and establishes some curious relations among the "rates of exchange" of different markets, but we must pass on to where, in search of the principles which shall govern his investigations, he clears his way by an onslaught, too well deserved, on his predecessors in this region. He says:

To lay the foundations of the theory of exchangeable values, we shall not, with the majority of speculative writers, remount to the cradle of the human race; we shall not take in hand to explain either the origin of property, or that of the exchange or division of labour. This all belongs without doubt to the history of man, but has no influence on a theory which can only become applicable at a very advanced stage of civilisation, a stage when (to use the language of geometers) the effect of the *initial circumstances* has entirely ceased.

We shall appeal to but one axiom, or, if you please, we shall employ one hypothesis alone, namely, that every one tries to get for his property or labour the greatest possible value. But in deducing the logical consequences of this principle, we shall attempt to fix, better than has yet been done, the elements or data which observation alone can furnish. Unhappily this fundamental point is that which theorists almost unanimously present to view in a manner, we will not say, false, but-absolutely meaningless. "The price of things," say they, with almost one voice, "varies directly as the demand, and inversely as the supply."

Our author then proceeds to shew, that, taken in its strict mathematical meaning, the principle is palpably wrong, but as we do not imagine that the writers who use it, ever meant it to bear such meaning, it is not necessary to follow him here: doubtless, the "variation" spoken of is only a loose way of expressing increase and decrease, without specifying that particular mode which is implied in the technical word "variation." The following is of more importance:

Besides, what are we to understand by the "demand?" It is without doubt not the quantity which is really sold at the demand of buyers, for in that case there would result from the pretended principle the consequence, which is in general absurd, that the dearer a commodity is, the more of it there will be sold. If by "demand," we are to understand only a vague desire to possess the commodity, abstraction being made of the limit of price which each demander implies in his demand, there is scarcely a commodity for which we might not consider the demand as infinite; and if we are to take count of the price at which each demander consents to buy, each provider consents to sell, what means the pretended principle? It is, we repeat, a proposition—not erroneous, but-devoid of meaning; and accordingly, all those who have agreed to announce it, have equally agreed not to make any use of it. Let us try to betake ourselves to principles less barren.

We must here condense somewhat. The law of the demand, that is, the relation between the price of a commodity and its sale, (for Cournot justly uses "sale" and "demand" as synonymous, no theory being able to take count of a "demand" not followed by a "sale") is altogether unknown, nor is it likely that experience could furnish data, or analysis supply a formula which should determine and represent it, depending as it does on circumstances so numerous and variable and often of so shadowy a character as to elude the subtlest grasp. All we know of it is, that *in general* the sale or demand of a commodity increases

when the price decreases, and *vice versa*: the qualification "in general" being here introduced to exclude certain classes of commodities, such for instance as articles of curiosity and *vertu*, where a considerable fall in the price might even annihilate the demand altogether: if diamonds could be manufactured as cheaply as glass, no one would buy a diamond ring. Such cases, however, may be neglected in the general theory. The rate of this increase or decrease of the sale, in consequence of the fall or rise of the price, is dependent on the particular commodity, and may be more or less rapid; in most manufactured products, the increase of sale would be more than doubled if the price were to fall one half: in other cases, such as the necessaries of life, fuel, bread, and the like, and in cases where the demand is a necessity to a limited class of consumers, as in workmen's tools, weapons of war, philosophical instruments, there might be a considerable fall in price without the demand being much affected at the time. Although this law of the demand is thus unknown, we are not thereby precluded from reasoning with regard to it, for by well known processes of analysis, properties of a function may be discovered when the function itself is undetermined. If we now consider the gross produce of any particular commodity, that is, the quantity sold multiplied by the price at which it is sold, it is clear that the value of this produce may be made as small as we please by diminishing the price sufficiently, for even if the commodity were given away, the consumption would still be a limited quantity. On the other hand, we can conceive a price so high as to put an end to the sale altogether, so that this gross produce would again vanish; between these two points therefore, there must be some particular price at which this same gross produce will have attained its greatest value possible; up to which point it has been increasing and afterwards begins to diminish—in technical language, it admits of a *maximum* value. This then is the one great lever with which Cournot is going to move the world of economics, and we shall now proceed very briefly to indicate the manner in which he has used it. Clearly, however, we are not able to plunge at once into the thick of the market, and demand that the principle shall be applied immediately to the first commodity we lay hold of; many circumstances must be first considered, and it will be wiser to begin with the simplest case we can conceive, even if it be a wholly imaginary one, and then proceed step by step till we arrive at a stage which may be approximately level with the actual condition of things as we see them around us. Not the least part of the merit of Cournot's treatise consists in his admirably-graduated progress from the simple to the complicated,

the imaginary to the real. Setting out then with the case of an absolute monopoly, where the production of a commodity is entirely in the hands of a single person, the price will be determined by the principle that the *net produce* of the commodity shall be a maximum; by the *net produce* meaning the revenue obtained by the sale, less the cost of production. If the cost of production increase, the price will also be increased, though not necessarily to the same extent, and if this increase of cost be not supported by the producer, but by the consumers or by the agents who convey to the consumers and are reimbursed by them, the commodity will always be enhanced to the consumer, and the net revenue of the producer will be diminished, yet the price paid to the producer may rise or fall according to the varying circumstances of the case. An important distinction here developes itself according as an increase of production is attended by an increase or decrease of the cost of production. In the majority of cases of manufactures the latter state will prevail; for, the larger the establishment, the less in proportion are its expenses. In the products of agriculture and in the working of mines, the contrary may often happen, and even in cases which at first sight have something parodoxical about them; for instance, it is said that the *Times* newspaper has reached such a circulation, that every extension of it diminishes the profits of the proprietors, the actual cost of production of each copy of the paper being less than the price charged for it, and the space devoted to the advertisements, from which the profits are derived, being filled to its utmost extent. Another curious class of cases falls between the above two,namely, those where the cost of production is unaffected, either by the increase or decrease of the production, and the price is consequently the same as if the commodity were produced without cost. For example, the expenses of a bridge which is supported by toll will be sensibly the same whether the passers over are few or many, and of a theatrical performance, whether the boxes are full or empty.

In all this investigation it has been supposed that there is nothing to prevent the producer from producing the amount which is required to give him his *maximum* revenue, nor on the other hand from lowering his price to that required for the same *maximum*. If otherwise, a totally different calculation is called for, which we need not here enter into.

Closely connected with the foregoing, is the theory of taxation, which may be considered as an artificial increase of the cost of production. We need only consider two sorts of taxes, the *direct* and

the *indirect*. The former levied on the net revenue of the producer, whether fixed or sliding, has no effect on the price of the commodity, nor on the quantity produced; neither does it in any way fall on the consumer. Not the less may it be prejudicial to the general welfare: the following remarks of our author are exhaustive:

"This tax, though it does not reach the consumer, may be nevertheless very hurtful to the public interest: not mainly because in restricting the wealth of the producer so taxed, it restrains his means of consumption, and so influences the law of the demand of other commodities, but especially because the portion taken away by the tax on the producer's revenue is commonly used in a way less profitable to the increase of the annual production of the national wealth, and of the well-being of the people, than if it had remained at the disposal of the producer himself. We shall not here examine the effects of this abstraction on the distribution of products, whether natural or manufactured, though doubtless this is the ultimate object of the problems connected with the theory of riches, but we may remark, in harmony with all the authorities, that the tax on the producer's revenue, even if it does not hinder the productive funds from producing as much as they did before the tax was imposed, is an obstacle to the creation of new funds for production, and even, where the tax is a sliding one proportional to the revenue, to the improvement of the existing funds. No one will employ his capital in the creation of new funds for production, or in the improvement of those existing, if, by reason of the tax with which he finds the net return of his capital affected, he no longer obtains the ordinary interest accruing from capitals employed in undertakings of the same kind. It is by closing the openings for employment of labour and industry that such a tax, when excessive, acts in the manner the most disastrous."

Of indirect taxes, we may distinguish the two kinds known as *specific* and *ad valorem*. In the former case, the loss sustained by the producer exceeds of itself the gross profit to the treasury, leaving the loss sustained by the consumers wholly uncompensated. Under this head may also be classed the system of *bounties* or *premiums*, the result being that the gain to the producer which is effected by the bounty, is essentially less than the sacrifice caused by the fall in price produced thereby. With regard to *ad valorem* duties, Cournot establishes a very beautiful and simple formula,* by which a duty of this kind is shewn to be equivalent to a certain increase in the cost of production or transmission of the commodity. Hence such a duty falls the heavier, according as the cost of production is greater. Just as in the *specific* duties, the loss sustained by the producer is greater than the income of the treasury, and that by the consumers is wholly uncompensated.

*If the tax on each unit of the commodity be to its price in the ratio of n to 1, the effect will be the same as if the cost of production were increased in the ratio of $(1-n,)$ to 1, Thus if the tax were 12 per cent., the increase of cost which would be equivalent to it would be about $13\frac{1}{2}$ per cent.

From the case of an absolute monopoly in the hands of a single proprietor, we pass to that where two independent proprietors are supplying the same market. Each of these will endeavour to render his own net revenue the greatest possible. If the two proprietors are in precisely similar circumstances, so that the sale by each is the same, then follows the curious result that the revenue derived according to the foregoing principle is less than that which would have been derived if the two sources had been united into one, or if the two had entered into partnership.

"How happens it then that producers, for lack of understanding, fail to stop, as in the case of monopoly or partnership, at the price which in effect gives them the greatest revenue? The reason is, that if one producer had fixed his production in accordance with such a condition, the other might with a momentary benefit carry *his* production to a higher or lower level: certainly, he would soon be punished for his mistake, because he would force the first to adopt a new level of production which would in return re-act unfavourably upon himself. But these successive reactions, far from bringing the two back to their original state, will make them deviate more and more widely from it. In other words, the state supposed will not be one of *stable equilibrium;* and although the most favourable for the producers, it will not be able to exist except by a formal compact between them, because we cannot suppose in the moral world men exempt from mistakes and inconsiderateness, any more than in physical nature we find bodies perfectly rigid, points of support absolutely fixed, and the like."

The same reasoning holds when the number of independent producers is more than two; the effect of the competition in all cases being to lower the price, a result which indeed we might well have asserted *a priori*, but which has here for the first time received from our author its logical exposition as a scientific fact. The most important, and the most common of this class of cases, is where the concurrence of producers is so great, that any partial production might be cut off without sensibly affecting the whole production or the price of the commodity: here then the effect of monopoly is entirely extinguished, and the benefits of this are are not less felt by the public than by our mathematician, whose calculus is wonderfully simplified in consequence. The same principle still governs the price; an increase in the cost of production, including the case of a specific duty, always raises the price, but to an extent which is in all cases less than the increase of cost; and any additional expenses incurred by the commodity after it has left the hands of the producers will lessen the price obtained by them. The loss sustained by the producers, by reason of the imposition of a specific duty, is less, while that sustained by the consumers is of itself greater, than the produce of the tax. Duties *ad valorem* follow precisely the same rule as in the case of a monopoly.

Hitherto, we have considered the commodity discussed to be a simple one—that is—one in which only one class of producers has been concerned: commodities of this kind do not, however, form the majority of ordinary products: we cannot do better than let Cournot himself speak, in introducing this important distinction:

"Very few substances are consumed in the state in which they issue from the hands of their first producer: generally one and the same substance enters into the composition of many different products that are more directly appropriated to consumption; and reciprocally, many primitive substances concur in the formation of each of these products. It is clear that each producer of primitive substances, ought to try to make the most of his property; and then we ought to investigate according to what laws are divided, among the different producers, the profits which they together make by virtue of the law of consumption of the ultimate products. This short *exposé* will be enough to render intelligible what we understand by the effect of the *concours* of producers of different commodities, an effect which must not be confounded with that of the *concurrence* of producers of the same commodity, which has already been discussed."

In fact, we arrive at a result precisely the opposite in this case of what we had in the former. The effect of competition among *concurrent* producers of the same commodity, was to lower the price: here the effect is to raise the price, and the division of proprietaries acts disadvantageously, not only for themselves, but the public; this disadvantage also being increased in proportion as the number of primitive substances concerned in the production of the compound commodity is greater. When an increase takes place in the cost of production of one of the primitive substances, or when a tax is imposed on it, the price of this one and of the compound commodity will be raised, and at the same time the prices of the other concurrent substances will be lowered, but the rise of price will be less than the assumed increase of cost or the tax. If a tax be imposed on the compound commodity, it will cause the price of each of its components to fall, while that of the commodity itself will be raised, but to an amount which is less than the tax. These results are of a very remarkable character, and, though established by a somewhat intricate calculus, there seems no reason to deny them the character which our author claims for them of possessing all the certainty of mathematical theorems.

The remaining portion of the work under review, is taken up with an examination of the sources from which the wealth of each nation is derived, and the effect produced thereon by the communication of markets. Our limits do not permit us to follow him through these investigations, and indeed, this part of his work is to us the least satisfactory of the whole. The analysis employed is not powerful

enough for the work, and our author is compelled to descend from his vantage-ground of rigorous scientific research, and enter into contest with the "ecrivains economiques," in that very arena of wordiness for which he has so justly reproached them. In some places also his reasoning may with justice be impugned, and we have therefore less compunction at cutting short our abstract. Enough has been said to give our readers an idea of the nature of this admirable treatise, and of the style of research pursued, and results obtained in it: we think it may truly be regarded as the first attempt, and a successful one, at founding a true science of wealth on the only base of observation and induction: we must, however, not forget, that the "theory of riches" is only one portion of the social economic field: the true *weal* of a nation depends, not merely on its wealth but infinitely more, on the mode in which that wealth is distributed, and the investigation of the "how and why" for this case must be the ultimate aim of all the problems of civil polity: we would recommend to the attention of our readers, the following eloquent and consoling remarks, with which Cournot closes his book:

We must remember that questions such as these, are not resolved by the argumentations of doctors, nor even by the wisdom of statesmen. A superior power forces nations into this or the other track, and when a system has had its day, sound reasoning will be as unavailing as sophistry, to restore to it the life it has lost. The craft of the statesman consists then in moderating the ardour of the spirit of innovation, without trying to maintain an impossible struggle against the laws of Providence. The possession of a sound theory can aid this labour of resistance to abrupt changes, and helps in facilitating the transition from one *régime* to another; by bringing more lights to the point in dispute, it extinguishes the passions that are in combat. Systems have their fanatics; science, which succeeds to systems, never has. Lastly, if the theories connected with the organisation of society, do not rule contemporaneous facts, they at least render plain the history of facts accomplished. We may up to a certain point, compare the influence of theories of polity on society with that of theories of grammar on language. Languages are formed without the consent of grammarians, and are corrupted in spite of them; but the labours of these bring day-light to the laws of formation and decay of languages; their rules hasten the period at which a language reaches its perfection, and retard somewhat the invasion of the barbarism and bad taste which corrupt it."

J. B. C.

Account of the U. S. Naval Astronomical Expedition to the Southern Hemisphere, during the years 1849,-50,-51,-52 ; *compiled by Lieut. Gilliss, U.S.N., Superintendent of the Expedition.* Washington, 1855: 2 vols , quarto.

The Expedition of which the work above named gives a description, was determined on by an act of Congress, in 1848, for the purpose chiefly of enlarging and correcting the catalogue of stars for the southern hemisphere. The station selected for the requisite observations, was Santiago, the capital of Chile, which from its geographical position, and the purity of its atmosphere, was admirably adapted for effecting the proposed objects. Lieut. Gilliss was directed, in addition to his astronomical labors, to collect materials for the advancement of the sciences of magnetism and meteorology, together with information relative to the natural history, the topography, and the political, social and commercial condition of Chili, and the contiguous countries.

It is with such miscellaneous matter that these volumes are principally filled ; a brief description only of the astronomical work is given at the end of the first volume; but the astronomical results will appear in additional volumes not yet published. The first volume prepared by the Superintendent, relates chiefly to the countries on the western side of South America. The second volume contains a narrative of two journeys across the Andes and Pampas, made by Lieut. MacRae, U.S.N., the chief assistant, together with some beautifully executed engravings of the specimens of natural history, mineralogy, and Indian antiquities, collected by the officers of the expedition, and accompanied by notices drawn up by scientific men in the United States, eminent in their respective departments.

The writers appear to have spared no pains in collecting materials for their work ; and while due regard has been paid to arrangement, they have succeeded in putting them together in a very pleasing and spirited style. As a book of travels, apart from its scientific character, it deserves certainly to occupy a very high rank.

The nature and extent of the labors in which the officers of the expedition were engaged, may be learned from the brief account given by Lieut. Gilliss, at the close of the first volume :—

During the summer and autumn months succeeding our arrival, there was almost uninterrupted fine weather. From the 10th of December, when the equatoreal was ready for use, night followed night unrivalled in serenity ; and to the close of the first series of observations on the planet Mars, Jany., 31, there were but four unsuited to work. Labour so continuous in a climate as dry almost as an oven, told severely on unacclimated constitutions ; and it was soon perceived

that the principal assistant must be temporarily released, or be broken down, perhaps permanently. The opportunity to send him to Valparaiso for the meridian circle, was therefore a welcome one. Messrs. Hunter and Smith, recorded for me on alternate nights, until the former was disabled by being thrown from a horse. All the aid was then from Mr. Smith; besides which duty, he became wholly charged with the meteorological observations for every third hour, between six, a. m., and midnight. Within the forty-eight working nights embraced between the above dates, nearly 1400 observations of the planet were accumulated; and by the time that this series terminated, the piers for the meridian circle were finally completed, the health of Lieut. MacRae re-established, and we were able to give undivided attention to its erection and adjustment; so that the instrument was ready for use about the middle of February.

But it must not be inferred that our nights from the 31st of January, were passed idly. Observations for approximate place of the circle had commenced some days before, and extra hours of every night were spent in becoming familiar with the details of the superb instrument that Messrs. Pistor and Martins had sent us from Berlin; and thus, by the time its adjustments were perfected, both of us were expert in its manipulation. Beginning within 5° of the south pole, a systematic sweep of the heavens was then commenced in zones or belts, 24′ wide. Working steadily towards the zenith on successive nights, until compelled to return below again to connect in right ascension, the place of every celestial body that passed across the field of the telescope, to stars of the tenth magnitude, was carefully noted down. The space immediately surrounding the south pole, was swept in one belt of 5° by moving the circle, and each zone overlaps those adjoining both in right ascension and declination. Above the polar belt there are forty-eight others, making in all 24 12′ of declination, within which we obtained 33,600 observations of some 23,000 stars, more than 20,000 of them never previously tabulated. * * * * * * From Oct. 1850, Messrs. MacRae and Phillip had the entire charge of the instrument for zone observations. When an accident to one of the screws compelled the services of both at the same time, until a new one was received from Berlin, I devoted every other night to the examination of the stars in the catalogue of Lacaille, and between the zenith and our upper zone, which had never been reobserved. * * * * * As may be supposed, the discrepancies between our estimations of the magnitudes of stars, and those of preceding observers were very considerable in a multitude of cases; but we endeavoured to preserve an uniform system, and will reconcile discordances if we can. There were many errors in Lacaille's work, at the Cape of Good Hope, and quite a number of his stars do not exist in the reduced places of the British Association publication; but we were only amazed that he should have been enabled to accomplish so much, and so well, with a telescope only half an inch in diameter, and in the brief space of ten months.

It was a great satisfaction to work with an instrument like ours, but there was almost too much of it. Out of 132 consecutive nights, after the equatoreal was mounted, there were only seven cloudy ones! Of necessity, to afford so large a proportion, the air must be exceedingly destitute of moisture, a condition of things favorable to telescopic vision, but not so to eyes employed during prolonged observations.

Much as the expedition succeeded in effecting, the continuous labor of mind and body occasioned by the nature of the work, and the limited number of assistants, together with the trying influences of climate, seem seriously to have interfered with its complete success. Lieut. Gilliss writes:

We were on the further extremity of the continent, and so distant that the words of my earnest appeal for help, grew cold before they reached home; unmistakeably convincing me before the close of the first autumn, that one of the objects of the expedition could only be partially accomplished. I had hoped the day was not distant, when astronomers would say, the American Navy has mapped the whole heavens. The observatory at Washington, had commenced a catalogue, intended to embrace all the stars that appear at a sufficient height above its horizon. With sufficient force we could easily have tabulated the remainder, and the noble work would have been a monument to the service for all time. But it was not to be. There is a limit to physical exertion under every clime, and we were not less human than our kind. I had only half the requisite number of assistants for an undertaking so laborious; and, fixing that limit at the utmost bound consonant with the preservation of health and vision, when my own time was occupied in observations of Mars or Venus, until the meridian circle was again in complete order, it was necessarily unused on alternate nights.

But if the success of the expedition was not in every respect commensurate with the ardent aspirations of it zealous and able superintendent, there is one collateral result which will be hailed with satisfaction by all friends of science—the establishment of a national observatory at Santiago. Mr. Gilliss goes on to say:

We had scarcely organized work systematically, before it was intimated to me, from the university, that the government (of Chile,) would probably establish an observatory at our departure, and to this end was desirous to have one of the professors of mathematics, and two of the most advanced and promising students of the National Institute, acquire a knowledge of the instruments. The utility of such an establishment. and the honor it would reflect on the country, had been urged by the Chilean Ambassador at Washington, prior to our departure from the United States; and it was a source of no little gratification to me, to witness the incipient step promptly taken towards the realization of an object so noble.

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Throughout nearly the three years of our residence at Santiago, the government evinced the most earnest disposition to forward the objects of the expedition, and to extend every possible consideration to its members, officially and personally. To its liberal and enlightened policy on all questions of science, literature, or art, the world is indebted for more than one valuable contribution; its schools of arts, music, painting, and botany, the elaborate work on its natural and political history, and its geological topographical survey, are all evidences of its generous patronage. The culminating step was yet to be taken; and there was a time when we had looked forward to this—the establishment of a national observatory at our departure, with something approaching to certainty. * * * Learning that my observations would cease about the middle of September, Professor Domeyko, then rector of the National Institute, was authorized to say

that the government would be glad to purchase our observatories as they stood. Dr. Charles Moesta, a graduate of the university of Marburg, was appointed director, and was placed in communication with me, so that he could become familiar with his instruments by the time we were ready to surrender them.

On the return to the United States, of the rest of the expedition by the Panama route, Lieut. MacRae was despatched home via Buenos Ayres, across the Andes and Pampas. The chief objects of this journey, were to determine the variation of magnetic intensity dependent on the distance from the earth's centre, to assist Baron Lindenau in his investigations relative to atmospheric refraction, and to collect general information respecting the geography and meteorology of the Andes and Pampas.

The entire journey occupied him about sixty days, of which twelve were employed in observations within the Andes. Accidents having unfortunately occurred to the chronometers, by which discredit might be thrown on the longitudes of his stations, Lieut. MacRae, on his arrival in the United States, volunteered to retrace his steps at his own cost if a new set of instruments were supplied to him. His offer being accepted, he embarked for Buenos Ayres, in August, 1853, crossed the Pampas and Andes to Valparaiso, and finally returned to the United States in March, 1854.

Reports of both his journeys are given in the second volume, occupying some eighty pages. With respect to his magnetic observations, to which he alludes very briefly, he remarks that he encountered much difficulty in making accurate observations in mountain passes, on account chiefly of local attraction and strong winds; he however, considers their accuracy sufficient to justify the deduction that the intensity diminishes with elevation, by some law as yet unknown.

But to return to the 1st volume. This, the exclusive work of Mr. Gilliss, is the more acceptable, from the fact that previous books, or most of them, respecting Chili, refer to a condition prior to the last quarter of a century, and describes what Chili was, instead of what it is.

In the opening chapter on descriptive geography, and in the following one, on the distribution of industrial resources, the author enters into various details relative to the physical and social causes which have operated in determining the position of the cities, the comparative progress of different districts, and their capacity for further improvement.

In the chapter on earthquakes, we read some vivid descriptions of

these terrific visitations, some derived from national records, others witnessed by the author himself.

Of the former class is the celebrated earthquake of 1835. The description refers chiefly to Concepcion and Talcahuano.

At forty minutes past eleven o'clock, the tremor commenced without noise, its violence gradually increasing during the first half minute, yet not so much as to cause general alarm. Meanwhile the rumble was heard, and at the end of that time, the convulsive motion became so strong, that the whole population fled to open places for safety. Before a minute had elapsed, the awful motion so increased, that people could scarcely stand; and in thirty seconds more, an overpowering shock caused universal destruction. Concepcion was a fourth time in ruins—its people shrieking under the agony of terror and bodily injury; the very ground on which they were prostrated gaping wide with every throb, and the atmosphere almost irrespirable with dust. From the first tremor to the termination of the great shock was two and a half minutes, during the longer portion of which time, none were able to stand unsupported; even animals spreading out their legs to avoid overthrow, and birds taking to the wing. * *
* * * * * * * * * *
Simultaneously with the beginning of the convulsion, the water rose about a foot in the river at Concepcion, and in the bay of Talcahuano, without first retiring, swelled up to high-water mark; but the great sea-waves came not for a long time afterward.

An hour and ten minutes had elapsed from the destruction of the town of Talcahuano, which was also destroyed, when,

The sea retired nearly a mile, leaving in the mud vessels that had anchored in from four to six fathoms water. A few minutes after, the first great wave approached in an unbroken wall of water, thirty feet high between the island of Quiriquina, and the western shore of the bay. It broke over everything within that distance of tide level; dashed the ships along like boats; bore one from the stocks where it was nearly ready for launching 200 yards inland; removed 24-pounder cannon some yards and overturned them; and finally, rushed back with such a torrent, that everything moveable not buried under the ruins was carried out to sea. The inhabitants occupied the heights at the back of the town, not less appalled at this display of resistless power than despondent at the ruin it caused them. Ships were again left aground in the bay, until half-past 1, p. m., (i. e. after an interval of one hour,) at which time a second wave was seen rolling through the same channel, with more impetuosity than the first, whirling them about each other as they floated, and was only less destructive in its effects, because there was less to destroy. Twenty minutes later, a third came onward. But this was crested—foaming like the breakers across a dangerous bar during a storm; and as it swept tumultuously along the shores, bearing everything irresistibly before it, the roaring noise was horrible. Quickly retiring, the sea was seen covered with wrecks of houses, furniture, and goods of every character, from the shattered magazines. Apparent exhaustion followed these efforts, for there were no more great waves, though for some hours the sea rose and fell two or three times each hour, and both earth and water trembled. * * * * * * * *

Several days elapsed before the tide rose to within five feet of the usual marks; and as late as the middle of April, there was still a difference of two feet, indicating an elevation of the coast to that amount—a fact substantiated by beds of dead muscles and limpets. At the same time the island of Santa Maria, 40 miles distant in a S.W., direction, and the southern shore of the neighboring bay of Arauco, were more affected. The former was upheaved an average of nine feet, its north end having been raised two feet more than the south point, whilst the main land S.E., of it was only left six feet above its previous height.

At the same time of the ruin, and until after the great waves ceased, the water in the bay was quite black, and from the bubbles of air, or gas that escaped was apparently boiling in every direction. It also exhaled a sulphurous smell, and destroyed shoals of fish, whose dead carcases added to the variety of floating objects. Whilst the waves were coming in, two explosions were seen, one a column of dark smoke, like a tower outside the Island of Quiriquina; the other resembled a huge jet of aqueous vapor, thrown up in the bay of San Vincente, which is separated from that of Tulcahuano by a narrow isthmus. At the disappearance of the latter, a whirlpool marked the spot, as though a cavity had been opened into which the sea was pouring. At one place in Talcahuano, and several near Concepcion, the ground swelled like large bubbles, and then bursting, discharged quantities of black and fetid water. * * * *

After describing some examples experienced by himself, he enters somewhat into the theory of earthquakes, and relates a fact showing the extent of a region simultaneously affected by the same shock. By means of the electric telegraph erected between Santiago and Valparaiso, it was ascertained that *these two cities 64 miles apart, had been shaken precisely at the same instant.*

Space does not remain to analyse or comment on the able and lucid remarks of the author on the government of Chile, the condition of its society, and the practices of its church; nor can we do more than call the attention of his readers, to the lively narrative of his visits to various districts in which many similar remarks are embodied. We shall be content to terminate this short notice by quoting from the concluding paragraph of the book, where the writer in language, we think, that speaks well both for head and heart, deprecates the charge to which too many travellers have justly exposed themselves: that namely of abusing the hospitality of their hosts, by betraying their defects. He writes:

Many things may have been told in the preceding pages, apparently ungracious from one who acknowledges so many attentions, so many acts of courtesy, and such valuable assistance; but I claim justification and pardon. These very acts would have inspired lasting regard for the people, even had not nature invested their country with elements to create thee strongest interest in its, and their welfare. And first, it is more than difficult for a foreigner to comprehend fully, or to appreciate properly the customs and motives for thought and action, of the nation in whose midst he tarries. He brings the standards of his own land by which to measure them; and though long residence may soften the home character

of his criticism, the impressions of childhood will not be effaced, but like magic ink will appear plainly whenever subjected to certain ordeals. Constant occupation prevented much of the intercourse that would have imparted some of these softening influences; and it may be that I continue scarcely more competent to truly estimate Chile and Chilenos than in 1849. Faithfully, however, has the motto been kept before me "nothing extenuate, nor ought set down in malice." More than this: next to my own, there is neither land nor people for whose prosperity and happiness I feel such earnest desire; none whose advancement I would make such efforts to promote. Will these sentiments give me a right to indicate faults; not as a censor regardless of the pain he inflicts, but as the friend who details errors that they may be the better corrected; the admirer who desires to perfect the object of his esteem? On these grounds I ask the indulgence of friends in Chile praying they will ever believe me grateful for their untiring kindness and hospitality.

G. T. K.

The Testimony of the Rocks: By Hugh Miller. Boston: Gould and Lincoln, 1857.

Hugh Miller's melancholy end has naturally stamped upon this work an interest of no ordinary kind. But apart from the adventitious interest with which it is thus surrounded, the intrinsic merit of the work itself, the grandeur of its theme, and its fresh and vigorous thought, garbed in the same picturesque word-painting as of old, may fairly claim for it a high place in the consideration of the thinking world. The "Testimony of the Rocks" consists of a series of lectures having for their primary argument the high antiquity of the globe, in opposition to that narrow view which the great Chalmers declared to be unsupported by the Mosaic Record, and which has long been virtually abandoned by many of our most eminent divines—amongst others, by the present venerable head of the Anglican Church itself. To use our author's words—

It is now exactly fifty years since a clergyman of the Scottish Church, engaged in lecturing at St. Andrews, took occasion in enumerating the various earths of the chemist, to allude to the science, then in its infancy, that specially deals with the rocks and soils which these earths compose. "There is a prejudice," he remarked, "against the speculations of the geologist, which I am anxious to remove. It has been said that they nurture infidel propensities. It has been alleged that geology by referring the origin of the globe to a higher antiquity than is assigned to it by the writings of Moses, undermines our faith in the inspiration of the Bible, and in all the animating prospects of the immortality which it unfolds. This is a false alarm. *The writings of Moses do not fix the antiquity of the globe.*"

The bold lecturer on this occasion,—for it needed no small courage in a divine of

any Established Church to take up, at the beginning of the present century, a position so determined on the geologic side,—was at the time an obscure young man, characterized, in the small circle in which he moved, by the ardor of his temperament and the breadth and originality of his views; but not yet distinguished in the science or literature of his country, and of comparatively little weight in the theological field. He was marked, too, by what his soberer acquaintance deemed eccentricities of thought and conduct. When the opposite view was all but universal, he held and taught that free trade would be not only a general benefit to the people of this country, but would inflict permanent injury on no one class or portion of them; and further, at a time when the streets and lanes of all the great cities of the empire were lighted with oil burnt in lamps, he held that the time was not distant when a carburreted hydrogen gas would be substituted instead; and, on getting his snug parsonage-house repaired, he actually introduced into the walls a system of tubes and pipes for the passage into its various rooms of the gaseous fluid yet to be employed as the illuminating agent. Time and experience have since impressed their stamp on these supposed eccentricities, and shown them to be the sagacious forecastings of a man who saw further and more clearly than his contemporaries; and fame has since blown his name very widely, as one of the most comprehensive and enlightened, and, withal, one of the most thoroughly earnest and sincere, of modern theologians. The bold lecturer of St. Andrews was Dr. Thomas Chalmers,—a divine whose writings are now known wherever the English language is spoken, and whose wonderful eloquence lives in memory as a vanished power, which even his extraordinary writings fail adequately to represent. And in the position which he took up at this early period with respect to geology and the Divine Record, we have yet another instance of the great sagacity of the man, and of his ability of correctly estimating the prevailing weight of the evidence with which, though but partially collected at the time, the geologist was preparing to establish the leading propositions of his science. Even in this late age, when the scientific standing of geology is all but universally recognized, and the vast periods of time which it demands fully conceded, neither geologist nor theologian could, in any new scheme of reconciliation, shape his first proposition more skillfully than it was shaped by Chalmers a full half century ago. It has formed since that time the preliminary proposition of those ornaments of at once Science and the English Church, the present venerable Archbishop of Canterbury, Dr. Bird Sumner, with Doctors Buckland, Conybeare, and Professor Sedgwick; of eminent evangelistic Dissenters too, such as the late Dr. Pye Smith, Dr. John Harris, Dr. Robert Vaughan, Dr. James Hamilton, and the Rev, Mr. Binney,—enlightened and distinguished men, who all came early to the conclusion, with the lecturer of St. Andrews, that "the writings of Moses do not fix the antiquity of the globe."

With a view to carry out systematically the object of the work, its two preliminary chapters, or lectures, are devoted to a popular review of the Palæontology of Plants and Animals; in which, amongst other facts, the relative perfectibility of the great typical groups with the geological advent of these, in clearly and forcibly shown. Upon a track so often traversed, little of actual novelty can, of course, be expected; but the singularly felicitous and graphic

manner in which the teachings of modern science are brought in all their force before the reader, may be gathered from the following quotation, extracted from the opening of the second lecture :—

"Amid the unceasing change and endless variety of Nature there occur certain great radical ideas, that, while they form, if I may so express myself, the groundwork of the change,—the basis of the variety,—admit in themselves of no change or variety whatever. They constitute the aye-enduring tissue on which the ever-changing patterns of creation are inscribed: the patterns are ever varying; the tissue which exhibits them for ever remains the same. In the Animal Kingdom for instance, the prominent ideas have always been uniform. However much the faunas of the geologic periods may have differed from each other, or from the fauna which now exists, in their general aspect and character, they were all, if I may so speak, equally underlaid by the great leading ideas which still constitute the master types of animal life. And these leading ideas are four in number. *First*, there is the *star-like* type of life,—life embodied in a form that, as in the corals, the sea-anemones, the sea-urchins, and the star-fishes, radiates outwards from a centre; *second*, there is the *articulated* type of life,—life embodied in a form composed, as in the worms, crustaceans, and insects, of a series of rings united by their edges, but more or less moveable on each other; *third*, there is the bilateral or *molluscan* type of life,—life embodied in a form in which there is a duality of corresponding parts, ranged as in the cuttle-fishes, the clams, and the snails, on the sides of a central axis or plane; and *fourth*, there is the *vertebrate* type of life,—life embodied in a form in which an internal skeleton is built up into two cavities placed the one over the other; the upper for the reception of thé nervous centres, cerebal and spinal,—the lower for the lodgment of the respiratory, circulatory, and digestive organs. Such have been the four central ideas of the faunas of every succeeding creation, except perhaps the earliest of all, that of the Lower Silurian System, in which so far as is yet known, only three of the number existed,—the radiated, articulated, and molluscan ideas or types. The Omnipotent Creator, infinite in his resources,—who, in at least the details of his workings, seems never yet to have repeated himself, but, as Lyell well expresses it, breaks when the parents of a species have been moulded, the dye in which they were cast,—manifests himself, in these four great ideas, as the unchanging and unchangeable One. They serve to bind together the present with all the past; and determine the unity of the authorship of a wonderfully complicated design, executed on a groundwork broad as time, and whose scope and bearing are deep as eternity."

After the two preliminary lectures alluded to above, the theological bearings of Geology in many of its leading questions, are taken up and discussed in several lectures with great fearlessness and power. From the known and sterling piety of their gifted author, combined with his equally recognised position in the scientific world, we regard these portions of Hugh Miller's work as peculiarly valuable in their advocacy of the true claims of geological science. It may be that here and there he fails to establish all his arguments in a thoroughly satisfactory manner, but the failure must be sought for

in the very nature of the questions touched upon. The main arguments however, the broad views of enlightened science as distinguished from bigoted empiricism on the one hand, and from skepticism on the other, are sustained by his close and varied reasoning, to their full. Were it not that the book must necessarily fall sooner or later into the hands of our readers, we should much regret our inability from want of space, to transcribe a few of the glowing pages belonging to this portion of its contents. In the lecture, more especially, entitled "The Mosaic Vision of Creation," we have a sketch of exceeding beauty, portraying the eventful and stupendous changes of the great geological DAYS, on the supposition that these were revealed to Moses in a series of visions. This idea however does not originate with Hugh Miller, as some of his biographers seem to infer. It has been brought prominently forward of late years by various authors, more particularly by the German Theologians. As our author observes, the visions of Milton's Adam when by the agency of the Archangel Michael the future was unveiled before him, may have given rise to this beautiful and by no means improbable conception. "Before the eye of the seer," says Professor Kurtz, of Dorpat, "scene after scene may have been unfolded, until at length, in the seven of them, the course of creation in its main momenta was fully represented." The vivid portraiture in the work before us of these wondrous phases in the ancient history of our world, is too long for quotation; and hence, as a final extract, all that our limited space will allow us to indulge in, we give the following eloquent passage from another lecture:

"Such, so far as the geologist has yet been able to read the records of his science, has been the course of creation, from the first beginnings of vitality upon our planet, until the appearance of man. And very wonderful, surely, has that course been! How strange a procession! Never yet on Egyptian obelisk or Assyrian frieze,—where long lines of figures seem stalking across the granite, each charged with symbol and mystery,—have our Layards or Rawlinsons seen aught so extraordinary as that long procession of Being which, starting out of the blank depths of the by-gone Eternity, is still defiling across the stage, and of which we ourselves form some of the passing figures. Who shall delare the profound meanings with which these geologic hieroglyphics are charged, or indicate the ultimate goal at which the long procession it destined to arrive?

The readings already given, the conclusions already deduced, are as various as the hopes and fears, the habits of thought, and the cast of intellect, of the several interpreters who have set themselves,—some, alas! with but little preparation and very imperfect knowledge,—to declare in their order the details of this marvellous, dream-like vision, and, with the dream, "the interpretation thereof." One class of interpreters may well remind us of the dim-eyed old man,—the genius of unbelief so poetically described by Coleridge,—who, sitting in his cold and dreary

cave, "talked much and vehemently concerning an infinite series of causes and effects, which he explained to be a string of blind men, the last of whom caught hold of the skirt of the one before him, he of the next, and so on, till they were all out of sight, and that they all walked infallibly straight, without making one false step, though all were alike blind." With these must I class those assertors of the development hypothesis who can see in the upward progress of being only the operations of an incomprehending and incomprehensible law, through which, in the course of unreckoned ages, the lower tribes and families have risen into the higher, and inferior into superior natures, and in virtue of which, in short, the animal creation has grown, in at least its nobler specimens, altogether unwittingly, without thought or care on its own part, and without intelligence on the part of the operating law, from irrational to rational, and risen in the scale from the mere promptings of instinct to the highest exercise of reason,—from apes and baboons to Bacons and Newtons. The blind lead the blind;—the unseeing law operates on the unperceiving creatures; and they go, not together into the ditch, but direct onwards, straight as an arrow, and higher and higher at every step.

"Another class look with profound melancholy on that great city of the dead,—the burial place of all that ever lived in the past,—which occupies with its ever-extending pavements of gravestones, and its ever-lengthening streets of tombs and sepulchres, every region opened up by the geologist. They see the onward procession of being as if but tipped with life, and nought but inanimate carcasses all behind,—dead individuals, dead species, dead genera, dead creations,—a universe of death; and ask whether the same annihilation which overtook in turn all the past, shall not onr day overtake our own race also, and a time come when men and their works shall have no existence save as stone-pervaded fossils locked up in the rock forever? Nowhere do we find the doubts and fears of this class more admirably portrayed than in the works of perhaps the most thoughtful and suggestive of living poets:—

"Are God and Nature then at strife,
That Nature lends such evil dreams?
So careful of the type she seems,
So careless of the single life;
'So careful of the type?' but no,
From scarped cliff and quarried stone,
She cries, 'A thousand types are gone.'
I care for nothing; all shall go:
Thou makest thine appeal to me:
I bring to life, I bring to death:
The spirit does but mean the breath:
I know no more.' And he,—shall he,
Man, her last work, who seemed so fair,
Such splendid purpose in his eyes,
Who rolled the psalm to wintry skies,
And built him fanes of fruitless prayer,
Who trusted God was love indeed,
And love creation's final law,
Though Nature, red in tooth and claw,
With ravine shrieked against his creed,—

Who loved, who suffered countless ills,
Who battled for the True, the Just,—
Be blown about the desert dust,
Or sealed within the iron hills?
No more!—a monster, then, a dream,
A discord. Dragons of the prime,
That tore each other in their slime,
Were mellow music matched with him.
O, life, as futile then as frail,—
O for thy voice to soothe and bless!
What hope of answer or redress:
Behind the veil, behind the veil!"

The sagacity of the poet here,—that strange sagacity which seems so nearly akin to the prophetic spirit,—suggests in this noble passage the true reading of the enigma. The appearance of man upon the scene of being constitutes a new era in creation; the operations of a new *instinct* come into play,—that *instinct* which anticipates a life after the grave, and reposes in implicit faith upon a God alike just and good, who is the pledged "rewarder of all who diligently seek Him." And in looking along the long line of being,—ever rising in the scale from higher to yet higher manifestations, or abroad on the lower animals, whom instinct never deceives,—can we hold that man, immeasurably higher in his place and infinitely higher in his hopes and aspirations, than all that ever went before him, should be, notwithstanding, the one grand error in creation,—the one painful worker, in the midst of present trouble, for a state into which he is never to enter,—the befooled expectant of a happy future, which he is never to see? Assuredly no. He who keeps faith with all his humbler creatures,—who gives to even the bee and the dormouse the winter for which they prepare,—will to a certainty not break faith with man,—with man, alike the deputed lord of the present creation, and the chosen heir of all the future. We have been looking abroad on the old geologic burying-grounds, and deciphering the strange inscriptions on their tombs; but there are other burying-grounds, and other tombs,—solitary church-yards among the hills, where the dust of the martyrs lies, and tombs that rise over the ashes of the wise and good; nor are there awanting, on even the monuments of the perished races, frequent hieroglyphics, and symbols of high meaning, which darkly intimate to us, that while *their* burial-yards contain but the debris of the past, we are to regard the others as charged with the sown seed of the future."

In conclusion, it should be stated that the value of the explanatory portions of the present work is much increased by the addition of numerous, well-executed engravings. Most of these, however, greet us with a strangely familiar aspect. The greater number appeared originally in a little elementary work in French by Beudant, and in the "Cours de Paléontologie," of Alcide d'Orbigny; but they have done duty since the epoch of their first appearance, in several English and German works; amongst others, oddly enough—when considered in connexion with the present book—in that work of very

opposite tendencies, the "Lehrbuch" of Carl Vogt. We must except however, the illustrations of the last two lectures—"The Fossil Floras of Scotland"—which appear to be original. These lectures: in a scientific point of view the most important in the volume, scarcely belong to the general plan of the work. and hence we have not alluded to them in our review. We trust, however, to give some extracts from them in a future number of the Journal.

E. J C.

The Canada Educational Directory and Calendar, for 1857-8; *containing an account of the Schools, Colleges, and Universities; the Professions; Scientific and Literary Institutions; Decisions of the Courts on School Questions, &c., &c. Edited by Thomas Hodgins, B.A.* Toronto: Maclear & Co., 1857.

It is no discreditable or unsatisfactory evidence of the rapid progress which Canada is making in the all-important step of providing for the intellectual growth of the province, that such a work as this can be issued with a reasonable prospect of its success as a trading speculation. The number of those interested in educational questions must be considerable, before such could be the case, and to all such the "Canada Educational Directory" can be confidently recommended. The courses of study and requirements for the various examinations in Schools and Colleges, for Masterships in Common and Grammar Schools, for Degrees in Universities, admission as Students or Barristers-at-Law, Surveyors, &c., are here set forth in an exceedingly convenient and accessible form. Lists are also given of the Office-Bearers, Professors, Teachers, Graduates, &c, with a brief, and on the whole impartial notice of the various constitutions of the very diverse educational institutions of the province. Here and there remarks occur reminding us of the conflicting opinions which prevent a perfect union among all the sincere promoters of a liberal education throughout the province; and one or two notes and comments scarcely correspond with the character of the work; but the editor deserves credit for the general aim at impartiality apparent throughout. In some cases information has been withheld, and in the whole compilation considerable labour must have been incurred to secure the accuracy in minute details, without which the object aimed at in its publication would be defeated.

In addition to the varied contents, thus summarily noticed, there is also a useful department, embracing the principal Scientific and Literary Associations of the province, which already begin to assume a very creditable aspect. Unpretending as this work is, it will be valuable to the historian of Canada, hereafter, when the harvest of this good seed-time is beginning to be reaped. We wish the work all success, and hope to see it established as a regular annual publication, improving yearly with the progress it records.

D. W.

Indigenous Races of the Earth; or new chapters of Ethnological Inquiry; including Monographs on special departments of Philology, Iconography, Cranioscopy, Palæontology, Pathology, Archæology, Comparative Geography, and Natural History: contributed by Alfred Maury, Bibliothécaire de l'Institut de France, &c. &c., Francis Pulszky, of Lubocz and Cselfalva, Fellow of the Hungarian Academy, &c. &c., and J. Aitkin Meigs, M. D., Professor of the Institutes of Medicine in the Philadelphia College of Medicine, &c. &c.,; presenting fresh investigations, documents, and materials. By J. C. Nott, M.D., and Geo. R. Gliddon, authors of "*Types of Mankind.*" Philadelphia: J. B. Lippincott & Co., 1857.

Such is the title, in a greatly condensed form, of the new work by the authors of the "Types of Mankind;" wherein they have carried out still further even, than in their former joint production, the cooperative system, applied of old so effectively in a very different branch of English literature; when Shakespeare, Jonson, Beaumont, Fletcher, and Massinger, conjointly produced works which defy the modern critic to apportion to each the product of his gifted pen. No such homogenous character, however, marks the modern literary edifice. Each independent labourer carves his own masonry, inscribes it with his mark, and places it, finished, at the disposal of the master-builder, to be harmonised as chance or fortune shall direct, with the stones that are ready to be built with it into the superstructure. The coherence in fact, is little more than such as pertains to the various independent articles which go to make up a cyclopædia, where absolute concurrence in opinions, or even in statement of facts, is not indispensable; while the whole makes

a bulky quarto volume, which, as it has just come to hand as these sheets are passing through the press, we can only notice very cursorily. And glancing first at that which comes last in the order of arrangement, the special chapters devoted to the controversial theme of "the Monogenists and Polygenists," or in simple words: the unity, or the diversity of the human race, as the descendants of one, or of several pairs; we cannot but regret the form in which it is here put forth, as calculated only to excite unnecessary prejudices against the whole inquiry. Notwithstanding the vehemence of its offensive and defensive warfare against all who venture to maintain their literal interpretation, in simple faith, of the words of their English Bible, that God "hath made of one blood all nation of men:" the author himself confesses that whilst according to his present opinions, "the reasonings in favour of the *diversity* view preponderate greatly over those against it, he does not, nevertheless, hold the latter to be, as yet, absolutely proven." Such being the uncertainty even in the mind of the boldest and most aggressive champion in the cause of a diversity of origin for the human race, we feel assured that the great majority of Ethnologists must deplore with us, the premature dragging into the arena of theological controversy of a science which is still in its mere infancy; has its data to accumulate, its first principles to determine, and even a commonly recognized nomenclature and termonology to agree upon; and is therefore totally unprepared to buckle on the armour fitted for offensive warfare. What faith can the simple learner be expected to repose, for example, in arguments based on Egyptian chronology, when no two of its authorities can be got to agree on its dates. Within a brief interval of five years, the era of Menes alone shifted back and forward over a range of variations differing by upwards of two thousand two hundred years. Since then it has shown no greater tendency towards a stable equilibrium. Bunsen, indeed, it would seem, from private information of his most recent views just received, (p. 587,) makes of Menes' Egyptian reign (B.C. 3623,) quite a modern era, and starting with the origin of mankind 20,000 years before Christ (!) he gives us an Arian migration circa B.C. 11,000; an Egyptian Republic, B.C. 10,000; a Theban Hierarchy B.C. 7,231; and an elective monarch extending from the precise date, B.C. 5,413 to the very year in which Menes—the first of us moderns—united Egypt under his single sceptre, exactly 5480 years ago! In some such comprehensive ante-historic eras, Mr. Gliddon fully concurs. "Egypt," he remarks in summing up an ideal

analogy, (p. 557,) "oldest of historical lands, representing, therefore but the 'middle ages,' of mankind's development upon earth, typified by our cosmic man, arrived at one third of the 'three score and ten years' imagined by Hebrew writers to be the average of post-mosaic human longevity, it follows that at the third dynasty, say 5300 years ago, the Egyptians at least, among, very likely, other oriental nations whose annals are lost, had long before passed through their periods of adolesence, childhood, and infancy." Yet the bewildered student who looks in vain for some *terra firma*, pretending not (as even the best educated of scholars or students of natural science may surely be allowed, without charge of unbecoming ignorance,) to judge for himself of Turin papyri, petroglyphic inscriptions, Apis-periods, and disputed dynasties, is not to suppose that he may ask for any definite chronology on which learned Egyptologers are agreed. The very Chevalier Bunsen, whose views are quoted approvingly on p. 587, as newly received, and interesting matter "in support of preceding remarks," is referred to on p. 487, before such new matters had come to hand, in these terms:—which disclose to us the the pregnant fact that even Mr. Gliddon is now reserving his own final decision, till the forthcoming of the long promised "Book of Kings" of Lepsius: "until the appearance of which, I have consistently maintained since 1844, no professed system of Egyptian chronology can, in the very nature of human things, possess solid or durable claims to attention: such as have recently appeared, worthy of respect, being either like M. Brunet de Presle's, a re-examination of the classical sources: or else like Chev. Bunsen's second volume, a labyrinth of arithmetical adjustments, satisfactory to no one but their learned calculator: or again, similar to the useful but very piece meal coverings of a skeleton chronology, by M. Brugsch, who, in the main, agrees with the time-measurements previously laid down by Lepsius; or finally, ingenious attempts at unsettling that which had been generally agreed upon, by Champollionists, through M. Poitevin's attorney-like process of detecting some supposititious flaw in the indictment. For myself, therefore, as before stated, I have no more precise Egyptian chronology to offer than that already sketched in *Types of Mankind;* and having waited some twelve years for Lepsius, it is small hardship to extend one's patience a few months longer."

But what, meanwhile, is the inquiring student to turn to, while waiting till the luminaries of Egyptian chronology shall have made up their minds what is to be believed? There is the Geological

department, with its *fossil* human remains :—*fossil* and *humatile*, to use a new word coined to designate that which has been accidentally deposited in the earth, in contradistinction either to the true fossil, or to purposed sepulture. Here at first sight then, is a startling array of facts :—the Guadaloupe skeletons ; the cave remains, found along with the *ursus spelæus*, extinct rhinoceros, elephant, &c., at Gard, Torbay, &c. ; the Floridian human jaws and foot, "embedded in a conglomerate at least 10,000 years old ;" and finally, the celebrated *os innominatum*, found near Natchez, on the Mississippi, below the skeleton of a megalonyx and other extinct quadrupeds. These and other instances quoted more extensively, and we may add more confidently, in the *Types of Mankind*, than in this later work, would seem at first sight to make up for any dubiety arising from the disagreement among Egyptian chronologers. But when the honest inquirer turns here for guidance to the authorities in science, Mantell tells him the Guadaloupe skeletons are quite modern ; Sedgwick, Buckland, and Hugh Miller, are agreed as to the recentness of the human cave bones ; Lyell gives the weight of his testimony against any argument based on the Natchez *os innominatum* ; and in fine, the geological argument for palæozoic human remains is sought for in vain in the accredited text books of geological science.

The like argument applies to the Archæological evidence. The flint implements, pottery, &c., found in British caves, where positive evidences of sepulture entirely remove them from being classed as contemporaneous with the embedded remains of any but the most recent extinct mammals, have even been found accompanied with specimens of art—Roman and other—belonging to the Christian era ; and as to M. Boucher de Perthes': "*Antiquités Celtiques et Antédiluviennes*," largely built upon in the *Types of Mankind*, pp. 353-372, and here again referred to, with further corroboration from later investigations of Dr. Rigollot: we can only say if the "antediluvian remains of art," of the latter explorer, are no better than those of the former, they will carry even less conviction to the minds o Archæologists, than the quoted examples of "fossil human remains" appear to have done to Geologists. We got hold of M. Boucher de Perthes' work years ago, when engaged in investigations which would have made us gladly welcome his conclusions, had his premises been even plausible ; and had he not accompanied his enthusiastic descriptions with his honest matter-of-fact illustrations, we should have been sorely puzzled to reject his "*figures et symbols de la période antédiluvienne*," his "*haches celtique, instrumens en pierre*"

and other specimens of "*industrie primitive*;" but having examined his eighty engraved plates, with hundreds of figured examples, we venture to say that any man may provide himself, blindfold, with equally good evidence of antediluvian and preadamite art, in the first heap of broken stones he stumbles over!

And what, let us now ask, is the position of this science of Ethnology, which undertakes to dictate to all older *ologies?* It is, as we have said, in its veriest infancy. Ethnologists are not as yet agreed upon the simplest common terms. Scarcely two of them can be warranted to mean the same thing when they employ such simple words as *race*, *family*, or *species*; to say nothing of *Arian*, *Touranian*, *Mongolian*, *Berber*, and the like, once more discussed here. The relative importance of philological, physiological, and archæological modes of investigation are so little determined, that the, craniologist slights the philologer, and the linguist in turn scorns the cranioscopist. Is such then a time for the students of this young and deeply important science to waste their energies in bootless controversies on questions, which, if truth were once established on a commonly recognised scientific basis, would vanish like the mists of dawn, before the sun? Such is the utter want of any conformity in the use of a received terminology, that in this very work, we find the term "*Caucasian*" employed by M. Maury (p. 84,) as equivalent to what he calls "the white race," and again by Dr. Meigs, (pp. 219-257,) confessedly unscientifically, as the most convenient one available under which to group such a miscellany as Norwegians, Fins, Germans, English, Irish Celts, Sclaves, Jews, Egyptian Fellahs, Thuggs, &c. Mr. Gliddon again has his own views on it (p. 563,) as a term of mystifying vagueness in Ethnography; or with the Count de Rechberg (p.p. 624, 625,) restores it to the only definite meaning it seems capable of, as "the highest type" among the multiform inhabitants of Mount Caucasus. What the present recognized scientific value of the word is, we defy any one to say. So with "*Pelasgian*"—if possible, a still looser and more debateable term. "Dr. Morton," according to Dr. Meigs, "used the term *Pelasgic* too comprehensively. The Circassians, Armenians, and Persians, should not be placed in this group." In his estimation, however, it appears that, "Ancient Romans, Greeks, Affghans, and Græco-Egyptians," all properly class as Pelasgic. Dr. Latham on the contrary, classes both *Persians* and *Affghans* under one "Persian Stock;" the modern *Greek* he would agree with Mr. Gliddon in recognizing as, to a great extent, Sclavonic. The seemingly

simple term *Roman* again, as included in the so-called *Pelasgic Race*, —what is its value or significance? It does not embrace the Etruscans; does it include Oscans, Umbrians, Sabines, Samnites? Does it apply to all Ancient Italians south of the Tiber, extending even to Magna Græcia? Or is it, after all only a political term, having no precise ethnographic value at all, but making of every Roman legionary a *Roman*, just as we may call, if we please, an Indian sepoy a British soldier? Such, as a specimen, is an analysis of the details of this Pelasgic classification according to recognised authorities. But what does the term itself signify? If we turn to Grote, the one conclusion he is sure about is that the Pelasgi were non-Hellenic; adding somewhat pungently an application of the comment of Herodotus on old Egyptian theories, to those who pretend to be wise above what is written, in this:—that "the man who carries up his story into the invisible world, passes out of the range of criticism!" Turn we again to Latham, and he tells us the Pelasgi were "*perhaps* slavonic;" while Clavier, Larcher, Niebuhr, Müller, and Raoul Rochette, may all be studied for conflicting theories on the meaning of the term here employed as a definite or definable one. In the table where it occurs, it is adopted only for convenience, but it is difficult to imagine a less convenient term than one which is the very symbol of controversy and division of opinion. And as the seemingly precise name of *Roman* is liable to the utmost ambiguity in the hands of the Ethnographer, so is it in like manner with the significant ethnic term "*Briton*" here employed in its loose non-scientific sense, as applied to the mere occupants of the British Isles; as, on the same pages we find Dr. Thurnam quoted as using that of *Anglo-Saxon* to indicate the clearly defined Germanic race of Pagan colonists of Britain in the centuries immediately succeeding Roman occupation; while when Dr. Morton is referred to, it is found applied to multifarious colonists of the New World: the very first example betraying the unscientific application of the term to one rejoicing in the thoroughly cambro-celtic name of *Gwillym!* In truth, when the American Ethnologist takes leisure to analyse the constituents of his own English-speaking fellow citizens; made up of Celtic: Irish, Scottish, and Welsh, fully as much at least as of Anglo-Saxon: Scot and Englishman; not to mention Gallic, Iberian, Italian, Polish, Hungarian, old Dutch, and modern Germanic continental elements;—still less the hybrid tinges of Red, or Black blood, which constitute the theme of one of the most interest-

ing chapters of this work,—he will take the edge off some of the finest *Anglo-Saxon* figures of speech of American oratory!

We believe the great majority of the students of this, the youngest of all the sciences, will heartily sympathise in the views which have guided Dr. Meigs of Philadelphia, in the treatment of the important department entrusted to him in the preparation of the volume under consideration. "I have confined myself," he remarks, "to a simple statement of facts, carefully and designedly abstaining from the expression of any opinion upon the prematurely, and perhaps in the present state of our knowledge, unwisely mooted questions of the origin and primitive affiliations of man. Not a little study and reflection, incline me to the belief that long years of severe and earnest research are yet necessary, before we can pronounce authoritatively upon those ultimate and perplexing problems of Ethnology." It is because we entirely concur in this opinion; and believe that the elimination of the necessary data on which Ethnological science must be built up, and the final recognition of the important truths which it is destined to establish, can only be retarded, by the diversion of its investigators into premature and bootless fields of polemics, that we have occupied so much space, with what we would otherwise have gladly left unsaid. What better can the Ethnologist hope for than that which has already been experienced by the Geologist; who has had to read in more recent octavos the recantation of his earlier quartos, and to confess on awaking, that, like Alnascar in the Arabian Tales, he had been expending the wealth of a dream in a triumph as baseless. It is facts alone we want at present; carefully, accurately, and unprejudicedly noted facts. These once accumulated, will fall into their order in due time, and the legitimate conclusions they point to, whatever they may be, will carry conviction to all honest seekers after truth, and find no lack of adherents "morally brave enough to avow them."

The "Indigenous Races of the Earth," is a work which embodies the results of much zealous industry and careful research. In one chapter, M. Maury discusses "The distribution and classification of Tongues;" going over ground investigated by Sir Wm. Jones, Jacob Grimm, Humboldt, and later philologists: and placing the important results arrived at in a very concise and agreeable form. Next come the "Inconograhic researches on human Races and their Art," by Francis Pulszky: an interesting and comprehensive monogram, admitted by Dr. Nott and Mr. Gliddon into their new volume, with

honest candour, as a correction of previous speculations in a similar line of inquiry. The essay is replete with interest, copiously illustrated, and embodies the fruits of a varied familiarity with ancient works of art, which has been fully appreciated by those who have had the privilege of listening to the lectures delivered by him in England on cognate themes. Nevertheless, in his Ethnological deductions, we see once more how far we are yet from any certain *terra firma*. Who, for example, shall determine the ethnic character of the Etruscans, when he must decide between Niebuhr, Donaldson, Raoul Rochette, Pritchard, Latham, and Pulszky? Here, however, is an accumulation of valuable materials, accompanied with highly suggestive hints as to the mode of using them, by the historical ethnographer, to whom such data will not be the less appreciated, even when he may claim the right to exercise his own judgement in determining their bearing on the general questions to which they are here applied, and the legitimate conclusions which flow from them.

Of Dr. Meigs' paper devoted to "The cranial characteristics of the Races of Men," it is sufficient to say that it is a valuable resumé of the labours of Morton, enlarged by many independent observations; with a cautious and discriminating effort to indicate the legitimate deductions which appear to its author to follow from the facts he has established.

Finally, it only remains for us to notice Dr. Nott's discussion of the important subject of "Acclimation; or the comparative influence of climate, endemic and epidemic diseases, on the races of men." Many of the questions discussed are of the highest interest. The nature and extent of acclimation for example, is curiously illustrated. So also, the effects of race, hybridity, various admixtures of blood, climate, &c., in reference to disease, as set forth from the results of observations extending over a course of twenty years professional experience, cannot but be studied with earnest attention, by all who have learned to appreciate the difficulties which gather around the great ethnological problem. The field of this author's observations, moreover, lies in that southern region of this continent where the meeting together of the white, red, and black races, under such peculiar circumstances, affords remarkable facilities for the accumulation of facts of the widest significance and value. Dr. Nott has his own special point of view, and he accordingly discusses those of Pritchard, and others who differ from him, with all the advantage of his practical experience, and command of authenticated personal observations. But besides his own data, he has accumulated much

curious information gathered from various independent sources, and from ancient and modern writers on the subject. Important statistical notes are compared and discussed in all their bearings, and partial deductions of former writers, are corrected by his own more enlarged experience. The conclusions he arrives at have already been set forth in the *Types of Mankind*, and need not now be discussed. The facts of such an observer are valuable contributions to science, independently of all deductions which to him may seem legitimately to flow from them. These are reiterated here in all their comprehensiveness, as conclusions drawn from "the long chain of facts" presented by himself and his collaborateurs in the production of the volume under review.

Such is a hasty glance at some of the varied contents of this new contribution to the science of Ethnology, from what may be specially designated as the American point of view. We have had to choose between a hasty notice of it immediately on its appearance, or a more careful study and discussion of its contents in a future number, when we must have followed in the wake of other reviewers, and referred to a book probably already in the readers hands. We have preferred the former alternative ; as our hasty notice may serve to direct the attention of some of our readers to it at an early date, and so afford them the opportunity of making for themselves such a careful and leisurely study of the varied contributions of its authors, as their merits deserve. We would only add, that the style in which the work has been produced, and the price at which it has been furnished to subscribers, amply justify the statement of the publishers, that monetary considerations have exercised little influence on the pains bestowed by the authors on their various contributions.

D. W.

SCIENTIFIC AND LITERARY NOTES.

GEOLOGY AND MINERALOGY.

CALCAREOUS CONCRETIONS FROM BUCKINGHAM, ENGLAND.

Dr. G. D. Gibb, of Guildford Street, London, has kindly forwarded to the Canadian Institute, a large collection of the peculiar concretionary bodies lately figured and described in the *Illustrated London News*, under the term of "Fossi Marine Vegetable Remains." These bodies occur in large numbers in a deposit of "brick clay" at Tingewick, near Buckingham, and are supposed to have been

derived from the denudation of the chalk beds of the neighbouring cretaceous districts. They appear to have attracted more than ordinary attention, various notices of them having been published by Mr. Stowe of Buckingham, (to whom the Institute is indebted for the specimens forwarded through Dr. Gibb,) the Reverend S. G. Osborne, and others; but concretionary bodies of a more or less similar nature, are well known to be of common occurrence, and frequently to present imitative forms of a very varied character.* As pointed out on their first discovery, by the Reverend Professor Sedgwick, the term "fossil vegetable remains," applied to these concretions, is altogether a misnomer; although the original perishable nuclei, around which the calcareous deposition took place—supposing a nucleus to have been present at all—may very possibly, though not necessarily, have been fucoidal. We quote the following passage from Dr. Gibb's communication, forwarded with the specimens in question:—"The presence of fossil infusoria seen in these specimens, does not necessarily prove them to be organic or marine, because we know very well that such bodies may have become incorporated or introduced from without, during the formation of the bed of clay from the debris of the chalk and other rocks. That such may be the case, I think there cannot be any doubt, and I am supported in this view by my friends Mr. J. W. Salter, Mr. T. Rupert Jones, and others. Mr Salter, moreover, thinks such concretions are the commonest things in nature, and such as might be expected in argillaceous matters containing carbonate of lime. They have assumed a flattened and compressed form, owing probably to pressure from the surface above. I am free to admit, however, that the material forming these concretions, may have become deposited around some marine vegetable remains, in consequence of the rather unusual forms assumed. In beds of clay employed for economic purposes, numerous concretions, assuming various forms, mostly rounded, are very frequently found by the workmen, especially when the clay contains much calcareous matter. The workmen call them "race," and they consist of quartz-sand, mica more or less decomposed felspar, peroxide of iron, and a large proportion of calcareous particles.† The greater part, if not the whole of the latter, Mr. C. H. Sorby, believes to have been derived from the chalk; for numerous characteristic fragments of the *Foraminifera*, of which that deposit is almost entirely composed, are found in it. He thinks such concretions are formed from a mixture of chalk and fine clay, and that they have become consolidated by the action of carbonic water. Such, I conceive would be also an explanation of the specimens from Tingewick, with the possible exception of a form or shape constituting a nucleus."

COAL FIELDS OF KENTUCKY.

The following remarks on the coal deposits of Kentucky, are extracted from the

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* We may mention here, that we have recently placed in the collection of the Canadian Institute, some peculiar, silicious concretions, (hitherto, we believe, unnoticed,) from the Black River Limestone of Lake St. John, near the Indian Village of Rama, north-east of Lake Simcoe, in Canada West. Some of these strikingly resemble bones of various kinds; and they present moreover, an internal cavity, often lined with a druse of minute quartz crystals. Their concretionary character is, however, quite evident. One of the specimens obtained, exhibits on its surface a strongly marked impression of the flat valve of an Orthis —probably *O. testudinaria, or O. costalis*. It may also be mentioned in connection with this subject, that the Palæotrochis of Emmons, a supposed fossil coral, has lately been shewn by Professor Hall, to be merely a concretionary structure. E. J. C.

† Quarterly Geological Journal, vol. 8, p. 186.

recent Report on the Geology of that State, by Dr. Dale Owen: 'In south-western Kentucky, the whole of eight counties, and a part of four other counties, are embraced in the middle coal field of the Mississippi valley, or the coal field which lies partly in Illinois, partly in Indiana, and partly in Kentucky. In eastern Kentucky, fifteen counties, and a large area of five more counties, are included in the great Appalachian coal field, *i e.* in the coal region occupying the western slopes of the Alleghany Mountains, and the Cumberland range, situated partly in Pennsylvania, Virginia, Ohio, Tennesee, and those above-mentioned eastern counties of Kentucky." . . . . After describing the boundaries of the south-western coal field, the author continues as follows: "The coal beds included in these counties, (Christian county, Baker county, &c.,) naturally divide themselves into Upper and Lower coal measures. These are separated from each other, not only by a prominent sandstone formation, (the so-called Anvil Rock,) but they have been cast off from continuity, immediately on the Ohio River, by an extensive uplift and dislocation of the geological formation which stretches from Gold Hill, on the Illinois side of the Ohio River, across the bed of that stream at Shawneeton, to Bald Hill, in Union County. The Topographical Assistant, (S. S. Lyon,) in his detailed survey of Union County, has traced a continuation of this upheaval in a nearly east and west course through the entire county. Beyond the Valley of Cypress, this disturbed belt has an increased width to the boundary of Henderson County. Beyond this point it has not yet been systematically followed; but the occurrence of disturbances, with a reversal of dip, near the confluence of Pond and Green Rivers, render it probable that it can be traced completely through the coal field. In Kentucky there is no evidence, whatever, that this disturbance occurred prior to the deposition of the coal measures; on the contrary, it has implicated in its movements, not only the sub-carboniferous limestone, and millstone-grit, but also the entire coal formation which lies in conformable dip on either side of the axis." Almost all of the coal beds are stated to occur in connexion with under clays containing stigmaria. At least eight workable seams occur in the Upper measures and ten in the Lower, varying in thickness, from about a foot to seven feet. Beds of clay iron ore are likewise abundant.

ZIRCON WITH BASAL PLANES.

The absence of the basal form, is one of the most salient characteristics of zircon crystals. M. Friedel, however, has recently announced* the existence of two small crystals in the collection belonging to the Ecole des Mines, in which this form occurs. These crystals are said to have been brought from Serro-de-Frio in Brazil. They have not been analysed, but their identity with zircon seems to be established by their physical and blow-pipe characters, and by the general correspondence of their angles with the measurements of that mineral. Besides the basal plane, the following forms, were also recognized, *viz*:—the first or diaxial vertical prism, (placed, however, as a monaxial prism in M. Friedel's figures, in conformity with the system of the French school); the triaxial pyramids or octahedrons P, $\frac{1}{2}$ P (not previously recognized), and 3 P; and the eight-sided pyramid 3P3. The new form denoted by the symbol $\frac{1}{2}$ P, comes out nearest to that notation, but the agreement is by no means close. According to M. Friedel's measurements, P : P (in the

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* Annales des Mines, tome IX, p. 620.

crystal in which the new form occurs,) = 125° 5′; making the vertical axis, 0,6082; whilst in the form in question, the same angle is stated to be 149° 30′ which would give 0,2834 for the vertical axis.

CALC-SPAR CRYSTALS FROM SOUTH AFRICA.

The cleavage rhombohedron of Calcareous Spar, in *simple crystals*, is well known to be exceedingly rare. As truly stated by M. Dufrenoy, the simple rhombohedrons often labelled "calc-spar" in collections, belong, in general to Dolomite. The writer of these notes, however, has lately received with other minerals from Namaqualand, in South Africa, several large crystals of calcareous spar, occurring in the simple cleavage form. Most of these crystals are somewhat distorted by elongation, and all are striated on the surface in the direction of a plane at right angles to the vertical axis. They are associated with trap, or trap tufa.

In the dolomite rhombohedrons, the obtuse angle over a polar edge, equals 106° 15′; and the presence of magnesia may be readily detected by dissolving the substance in a few drops of diluted hydrochloric acid—adding a drop of nitric acid, and boiling (to convert any $Fe\,O$ that may be present, into $Fe^2\,O^3$)—and precipitating by ammonia and oxalic acid the iron (if present) and the lime. The magnesia can then be thrown down from the filtered solution, by phosphate of soda, and tested with nitrate of cobalt before the blowpipe. If conducted in test-tubes, and on small quantities, the whole process need not occupy more than ten minutes.

The following logarithmic formula (extracted from some notes by the writer, in the Phil. Mag. of August, 1853,) for the determination of the vertical axis in rhombohedrons, may not be unacceptable to some of our readers:—

Let a = half the inclination, as obtained by measurement, over a polar edge; b, the inclination of a rhombohedral face on the vertical axis; and v, the axial length required. Then:

$$\text{Log}\cos b = \log\cos a + 0.0624694\,;$$
$$\text{Log}\, v = \log\cot b - 10.0624694.$$

E. J. C.

PHYSIOLOGY AND NATURAL HISTORY.

CANADIAN STRIGIDAE.

In communicating the following notes on the Canadian Strigidae, the object is mainly to procure information. Nevertheless, those who have not studied the subject may be interested in learning how many varieties of these curious and remarkable birds frequent the neighbourhood of Toronto ; as well as in knowing that a tolerably complete collection of specimens of them have been admirably preserved for the University Museum, by the late Mr. Hadgraft and Mr. Passmore, and cannot but prove attractive to every lover of natural objects. It is not, perhaps, presuming too much to hope that intelligent and scientific gentlemen of this district, on observing what has been already procured will use their endeavours to extend the list and assist in obtaining the few other species still wanting, among the more familiar examples, or any novel or rare forms which may present themselves.

The nocturnal Raptorial birds forming the family of STRIGIDAE or owls, are divided by Mr. Gray into four sub-families.

The SURNINAE, or Hawk owls, have the head small in proportion, without tufts, and with the facial disc imperfect above the eyes.

The University Museum possesses *Surnia Ulula*, the hawk owl, a moderate sized species abounding in the fur-countries, and occasionally seen in our district.

Nyctea Nivea, the Snowy owl, a well known and very handsome bird; and one example out of several, we might perhaps hope to obtain, of the genus *Athene passerinoides*, one of the birds popularly confounded under the name of the *little owl*.

The sub-family BUBONINAE, have the head broad and somewhat flat, with usually two prominent tufts; the facial disc being imperfect above the eyes.

The most conspicious example is *Bubo Virginianus*, the great Virginian horned owl, one of the larger sized, of very beautiful and characteristic form. Besides this, we have two species of *Ephialtes*, small owls of interesting character:

Ephialtes Asio, the American Scops eared owl, or little screech owl, and *Ephialtes Nudipes*, the naked footed owl, which latter may probably belong to a different genus.

The sub-family of the SYRNIINAE, (the name of which comes too near in sound to the first,) has the facial disc complete above, the tuft often absent, and when present, of fewer feathers. It affords us two fine species of Syrnium:

Syrnium cinereum, the great cinereous owl, a magnificient bird inhabiting deep woods, abounding in the fur countries, and occasionally visiting this more southern district, of which the University has recently obtained a pair from Mr. Passmore; and,

Syrnium nebulosum, the barred owl, one of the commonest species in our neighbourhood.

There are also in the collection two species of *Otus*:

Otus Wilsoni, the American long eared owl, which has generally been confounded with *Otus vulgaris*, the European long eared owl, but is abundantly distinct, and,

Otus Brachyotus, the short-eared owl, common to both continents.

The remaining sub-family, consists of the STRIGINAE, Barn owls, a race entirely without tufts, with the facial discs complete, generally of a somewhat triangular figure.

Not to leave the group without illustration, a European specimen of *Strix Flammea*, the common barn owl, or white owl, stands with the others. This species is said to belong to America, as well as Europe, but Audubon, gives reasons for supposing the American form to be distinct, and judging from his fine figure compared with the European bird, there is no doubt that he is right. The American specimens have hitherto been found exclusively in the south, whereas the European bird might rather be expected to inhabit more northern regions. Eleven species of owls now in the University Museum, have been procured around Toronto in a short period, and it may be reasonably hoped that further additions will be contributed to the collection from the same neighbourhood, as well as from other parts of the Province.

The University collection contains in almost every instance, a pair of each species, displaying well the sexual differences in size and plumage.

W. H.

ETHNOLOGY AND ARCHÆOLOGY.

CRANIA OF THE ANCIENT ROMANS.

Among the abstracts of papers in the departments of Ethnology, printed in the Report of the British Association for 1855, is one by Joseph Barnard Davis, M.R.C.S; F.S.A., on the forms of the Crania of the Ancient Romans, which possesses an interest on various grounds. There is indeed an important element of error, probably not overlooked by the discriminating observer, though unnoticed in the following abstract. It would be contrary to all known facts to assume that Crania found in Roman Cemeteries at the British sites named below, were necessarily those of Romans. In the majority of cases, our information would justify an opposite conclusion. The Roman Legions, were *Roman* only, politically, not ethnologically. At Eburacum for example, the permanent station of the Sixth Legion, the memorial inscription of Lucius Duccius, proves that he was a native of Gaul; while the inscriptions on tiles found there, pertain both to the sixth, and to the ninth, a *Spanish* legion. Inscriptions on altars and sepulchral slabs; the *Notitia;* the earlier notices by Tacitus of the Roman forces in Britain &c., all combine to prove that of the ethnological elements introduced into Britain by Roman occupation, we must include Gauls, Germans, Iberians, Greeks of Asia Minor, and even Africans; and indeed so small was the actual Italian element of population, that it would be difficult to over state the chances of an Anglo-Roman Sepulchre containing a representative of any of the conquered provinces of the empire, rather than by an actual Roman. In the special case however, described, and chiefly dwelt upon here, it will be seen that means of identification existed, and receive due consideration. The following is the abstract of Mr. Davis's paper, containing ampler details on a subject previously noticed in the Canadian Journal, (vol. I, p. 76.)

"A numerous series of ancient Roman skulls, derived from three different sources in Italy and from the Roman cemeteries at Eburacum, Londinium, Lindum, and Glevum, has fallen into the hands of the author. As the basis of these observations, he selects the cranium of THEODORIANUS, a Roman of consequence, who died at Eburacum in his 35th year, and whose inscribed stone sarcophagus was discovered many years ago. The venerable antiquary of Roman York, the Rev. Charles Wellbeloved, has referred him to a Roman family of Nomentum, a town of the Sabini in Italy. His skull is an elegant example of the capacious Roman cranium. It is marked by the squareness of face common to the *typical* form of the Roman head, the fine prominent nasal bones of aquiline profile, their position being more expressed from the broad nasal processes of the superior maxillæ—the expanded and capacious forehead, of somewhat low elevation, terminating below in a prominence of the supra-nasal region, which distinguishes it from the regular skull of Grecian type. It may be regarded as belonging to the typical section of ancient Roman crania, although not presenting the typical character in so decided a form as others exhibited. It will come under the division of what may be called *platy-cephalic* crania, those distinguished by a horizontal expansion of the vertical region. The diacritical marks which distinguish the crania of the ancient Britons from those of the ancient Romans may be expressed as follows: after remarking that those of the Romans were decidedly the larger, he adds :—The face of the *former* was rather shorter, more

irregular, deeply marked by muscular impressions, with a frowning supra-nasal and supra-orbital prominence; short but abruptly eminent nasal bones, rising suddenly out of the depression at the root of the nose; the forehead narrower, yet rising at about the same angle to nearly an equal elevation. The face of the *ancient Roman* was slightly longer, fully as wide in all parts, and sensibly wider in the frontal region, and as the angles and condyles of the lower jaw. This increased breath at the two extremities, with want of elevation of forehead, imparted to the countenance that quadrangular appearance so commonly observed in the statues of ancient Romans of Consular and Imperial times. The calvarium in the *typical* British skull is marked by particular shortness; that of the ancient Roman viewed vertically is not remarkable for shortness, whilst it preserves a considerable breadth. It is fully half an inch longer than the British, and yet somewhat wider. Commencing in the frontal region, this width extends to the temporal in all its parts, and to the parietal. It is on this feature we are disposed to rest its peculiarity, and to call it *pealty-cephalic*, to express that especially expanded form belonging to it without marked loftiness. Probably ancient British and Roman skulls agree pretty closely in elevation. The well-known peculiarity in the nasal bones of the latter, mostly conjoined with remarkable breadth and elevation of the nasal process of the superior maxillary, is another typical mark.

The author next refers to two selected from several skulls obtained from burials on the Via Appia—to a series derived from the Roman cemetery without the south-western gate of Eburacum in 1852—to others obtained from the Roman Cemetery of Londinium in the Borough, dug up from the 'Roman level' about 16 feet below the present surface. He compares the physical characters of the ancient Romans with those which may still be observed in the modern population of Italy, and infers that 'notwithstanding the vicissitudes of all the ages intervening between the present and imperial times, we have just ground for believing that the indicia of the ancient Roman people are still unextinguished in their descendants.' He concludes by suggesting the inquiry into the degree in which these peculiarities of the Romans may be traced in the people of Britain."

Since this notice of the general subject of Roman Crania, and of the special example from Roman York was read before the British Association, the York Cranium has been figured in the beautiful and valuable work, the "Crania Britannica," now publishing under the joint editorship of Mr. Davis and Dr. Thurnam. We shall have an opportunity of noticing its earlier fasiculi in a future number.

D. W.

CANADIAN INSTITUTE.

FIFTH ORDINARY MEETING.—*24th January*, 1857.

The Hon. the Chief Justice DRAPER, C. B., President, in the Chair.

The following Gentlemen were elected Members:

GEORGE S. MCKAY, Esq., Toronto.
JAMES H. MORRIS, Esq., Toronto.
Dr. B. H. STAMERS, Toronto.
Dr. WALTER GEIKIE, Toronto.

The following donations were announced, and the thanks of the Institute voted to the Donors:

1. By Henry G. Bohn, Esq., London, England, per A. H. Armour, Esq., ;
   "Forster's Critical Essays." Vol. 1.
   "Guizot's History of Civilisation," in three volumes.
   "Thierry's Norman Conquest," in two volumes.
   "Michael Angelo and Raphael."
   "Walton's Complete Angler," by Jesse, Plates.
   "Masterman Ready, or the Wreck of the Pacific," by Capt. Marryat.
   "Blair's Chronological Tables, enlarged and continued." Double volume.
   "Memoirs of the Duke of Sully, Prime Minister to Henry the Great," in four volumes.
   "Pliny's Natural History." Vol. 5.
   "Quintlian's Institutes of Oratory." Vol. 2.
   "Demosthenes against Midias," &c. (Kennedy.)
   "Dictionary of Classical Quotations."
   "The Crystal Palace Company."
   "Life of George Washington," by Washington Irving. Vol. 3.

2. By Hon. J. M. Brodhead, Washington, per A. H. Armour, Esq., :
   "Regulations for United States Consular officers."
   "Report on the Finances (United States), 1855-6."
   "Commerce and Navigation of the United States for year ending 30th June, 1856."

3. From His Excellency the Governor General, per R. T. Pennefather, Esq. :
   "Address on the opening of the One Hundred and third Session of the Royal Society of Arts, London; delivered by Col. Sykes, F.R.S., Chairman of the Council, Nov. 19th, 1856." Pamphlet.
   "Parliamentary List of Council and Officers, and Committees of Reference. Two pamphlets.

4. By Professor H. Y. Hind, M. A.:
   "A collection of Geological Specimens, consisting of:
   Trilobite Beds: Utica Slate, Blue Mountains, Collingwood.
   Graptolite: Red River, Humber, Hudson River Group.
   Fucoid, from the Hudson River Group, Humber River.
   Ripple Mark, - do.
   Black River and Bird's eye Limestone, from Lake Couchiching
   Tracks of Crustacea, Potsdam Sandstone, Beauharnois."

The following papers were then read:

1. By Professor Kingston, M.A., :

"On the practical application of the Electric Telegraph, for predicting storms."

On the motion of Colonel Baron de Rottenburg, it was ordered that Professor Kingston's paper be referred to a committee, with a view to bring the matter under the notice of the Government, and that the committee consist of Professors Kingston, Croft, and Cherriman, and the mover.

2. By Professor Chapman:

"On some Crystals of Carbonate of Lime, from South Africa."

SIXTH ORDINARY MEETING.—31*st January*, 1857.

The Hon. the Chief Justice DRAPER, C. B., President, in the Chair.

WILLIAM BENNET RICH, Esq., Goderich, was elected a Member.

The following Donations were announced and the thanks of the Institute voted to the Donors:

1. By the Trustees of the New York State Library:

"Copy of a new Catalogue, and several Pamphlets."

2. By Major F. Wells, Royal Regiment:

A Stone Hammer, picked up in one of the Trenches of Sebastopol, third parallel left attack, about three feet six inches under ground.

Major Wells, by whom this interesting relic was secured while actively engaged in the Siege of Sebastopol, being present, the President conveyed to him the thanks of the Institute for this donation, as a relic of the past, rendered doubly valuable from its constituting also a memorial of the memorable war in the Crimea.

The following paper was then read:

By Professor WILSON, LL.D.:

"On the antiquity of the use of Narcotics in the Old and New World."

SEVENTH ORDINARY MEETING.—7*th February*, 1857.

Colonel BARON DE ROTTENBURG, Vice-President, in the Chair.

The following Gentlemen were elected Members:

Mr. Sheriff TREADWELL, L'Original, C. W.,
ROBERT HEDDLE, Esq., Toronto.
WILLIAM COBB, Esq., Solicitor, Toronto.
RICHARD GRAHAME, Toronto, (Junior Member.)

The following papers were then read:

1. By Professor D. WILSON, LL.D.:

"On the Customs, Usages, and Superstitions of the Old and New World, in relation to Tobacco and other Narcotics."

In illustration of this paper, Mr. Paul Kane exhibited a curious collection of Pipes, and other specimens of American native art, executed and used by the various Indian Tribes of the North West.

2. By Rev. Professor HINCKS, F.L.S.,:

"Notes on the Strigidae found in the neighbourhood of Toronto."

Specimens were exhibited from the collection belonging to Toronto University

EIGHTH ORDINARY MEETING.—14*th February*, 1857.

Professor E. J. CHAPMAN, Vice-President, in the Chair.

The following Donations to the Library were announced, and the thanks of the Institute voted to the Donors:

From A. H. Armour, Esq:

"Outlines of the Geology of Ohio, by C. W. Whittlesay, with a map.

From the Author:

"Natural History of Vermont, a Lecture by Z. Thompson."

"Preliminary Report on the Geology of Vermont."

Tho followiny papers were then read:

1. By JOHN LANGTON, Esq., M. A.,:

"On the early French discoveries in North America."

Mr. Langton illustrated his paper with a series of tracings of early French maps, which he presented to the Institute.

Ordered, that the thanks of the Institute be presented to Mr. Langton, for his valuable donation.

2. By Professor CHAPMAN:

"Remarks on the classification and leading characteristics of Palæozoic Corals," illustrated by means of explanatory drawings.

NINTH ORDINARY MEETING.—21*st February*, 1857.

Prof. E. J. CHAPMAN, Vice-President, in the Chair.

The following Donation for the Library was announced, and the thanks of the Institute voted to the Donor;

From the Hon. J. M. Brodhead, Washington:

"Statistical Report on the Sickness and Mortality in the Army of the United States, from January 1839, to January 1855." 1 vol.

The following Gentleman was elected a Member;

W. R. ABBOT, Esq., Toronto.

The following papers were then read:

1. By P. FREELAND, Esq.,:

"On a new construction of the stage of the Microscope."

2. By Prof. KINGSTON, M.A.,:

"Report on the Meteorological Observations made during the year 1856."

TENTH ORDINARY MEETING.—28*th February*, 1857.

Prof. E. J. CHAPMAN, Vice-President, in the Chair.

The following Donations for the Library were announced, and the thanks of the Institute voted to the Donors:

1. From the Hon. J. M. Brodhead, Washington, per A. H. Armour, Esq., Toronto:

"Commercial relations of the United States, with all other Nations." Part I., vol. I.

"United States Naval Astronomical Expedition." Vol. VI.

"Proceedings of the Commission for the Settlement of Claims between the United States and Great Britain."

2. From Ecole des Mines, Paris:

"Annales des Mines, Tome VIII., IX.

On the motion of F. W. Cumberland, Esq., seconded by Rev. W. S. Darling, Dr. S. Stratford, of New Zealand, was proposed as a Corresponding Member.

The following paper was then read by Prof. Croft:

"Notes on the Natural History of New Zealand, by S. Stratford, M.D."

A Donation of illustrative specimens was laid on the table, from Dr. Stratford.

Ordered, that the cordial thanks of the Institute be presented to Dr. Stratford, for his valuable donations, and for the accompanying information in regard to New Zealand.

Colonel Baron de Rottenburg gave notice that the Report of the Committee, to whom was referred the communication of Lieut. Ashe, Royal Navy, relative to the extension of the Astronomical Observatory at Quebec, would be taken up at the next meeting.

ERRATUM.—Page 176, line seven from bottom, *dele* "spirit of the."

MONTHLY METEOROLOGICAL REGISTER AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—FEBRUARY, 1857.

Latitude—43 deg. 39.4 min. North. Longitude—79 deg. 21 min. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Mean Temp. + or − of the Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resul't. Direc-tion.	Direction of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M	2 P.M	10 P.M	ME'N		6 A.M	2 P.M	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M	10 P.M		6 A.M.	2 P.M.	10 P.M.	Re-sult'.	ME'N		
					°	°	°	°	°												°							
1	29.437	29.505	--	—	7.5	11.8	—	—	—	.046	.061	—	—	.69	.77	—	—	s w b w	s w b w	w s w	s 64 w	17.5	17.7	9.5	11.00	11.29	...	...
2	.675	.780	.942	29.8118	2.1	10.8	-5.9	3.72	—20.13	014	052	.032	.046	81	69	.89	.82	w	w n w	n n w	n 71 w	11.2	15.0	0.4	7.51	7.92	...	Inap
3	30.005	.908	.591	.8100	2.5	20.2	27.6	17.62	— 6.15	044	085	129	089	84	75	84	81	w n w	s e b e	e b n	s 66 e	4.1	10.0	5.5	5.40	7.01	...	2.0
4	29.465	.781	.949	.7583	32.8	34.6	27.4	31.43	+ 7.75	173	155	130	153	93	76	86	86	Calm	n b w	n	n 20 e	0.0	11.5	5.2	6.19	8.61	...	0.2
5	.817	.642	.569	.6682	25 6	31.0	34.6	30.93	+ 7.35	135	173	199	171	95	100	99	98	e b n	e b n	Calm.	n 76 e	17.5	12.0	0.0	6.23	7.08	0.750	...
6	.739	.692	.616	.6910	37.8	40.2	41.8	39.95	+16.43	225	213	227	222	100	86	86	91	Calm.	e b e	e n e	n 71 e	0 0	5.0	4.0	2.39	3.07	0.020	...
7	.578	.459	.313	.4355	43.3	49.6	48.0	47.08	+23.65	251	232	227	239	90	66	68	75	e b s	s	s b e	s 7 e	2.4	9.5	15.0	8.17	8.78	0.080	Inap
8	.277	.655	—	—	10.7	27.6	—	—	—	243	133	—	--	97	87	—	—	s w b s	w b s	n w b w	s 82 w	9.5	21.5	15.5	17.47	19.98	0.090	0.5
9	30.195	30.166	29.992	30.1088	15.4	22.1	25.2	21.33	— 1 93	077	073	104	088	84	60	75	74	w s w	s	s b w	s 22 w	11.0	9.5	23.2	16.28	17.80	...	...
10	29.850	30.237	30.351	30.1662	14.4	6.8	0.5	6.72	—16.55	082	048	040	053	93	75	83	81	n w b w	w n w	w s w	n 76 w	13.4	27.0	12.0	18.79	20.57	...	Inap
11	30.310	30.329	30.339	30.3165	-1.5	9.0	8.6	4.38	—18.88	042	060	050	050	94	85	73	85	n b w	w b n	s w	n 70 w	9.5	3.5	4.0	3.48	5.79	...	Inap
12	30.314	30.113	29.834	30.0670	8.2	22.7	31.0	22.18	— 1 07	058	103	160	112	85	82	93	86	n e b n	e	s b e	s 58 e	7.5	10.0	7.5	8.57	11 50	...	...
13	29.624	29.738	.911	29.7870	36.8	42.5	39.9	36.02	+12.77	181	158	111	152	83	59	67	72	s s w	w s w	n w	s 76 w	15.0	15.5	11.0	9.08	11.50	...	...
14	30.038	.822	.505	.7753	23.8	32.4	37.5	31.83	+ 8.57	128	162	211	170	97	89	95	93	n n w	e b n	s	n 80 e	3.2	13.0	4.0	4.76	8.90	0.055	...
15	29.568	.592	—	—	10.7	42.5	—	—	—	244	268	—	—	97	100	—	—	s b w	Calm.	n b e	s 51 e	3.0	0.0	6.5	0.45	3.35	1.620	...
16	.544	.544	.618	.5720	41.5	44.4	38.6	40.98	+17.62	254	280	226	248	98	97	97	97	s	s	s b e	s 7 e	3.5	0.2	0.3	1.10	1.11	0.210	...
17	.607	.478	.512	.5280	35.3	48.7	51.2	44.35	+21.00	206	307	346	277	100	90	93	95	s b e	e	s w b w	s 72 w	1.2	2.5	8.6	1.76	4.70	0.005	2.2
18	.638	.702	.669	.6642	44.4	41.3	33.2	38.02	+14.58	246	208	171	197	86	81	91	87	n w	n w b n	n e	n 10 w	9.8	11.4	6.5	7.14	8.06	0.115	1.5
19	.713	.778	.841	.7858	27.4	28.8	27.7	28.17	+ 4.63	135	140	135	136	89	88	88	87	n n w	n e b n	Calm.	n 32 e	6.0	3 0	0.0	2.47	2.67	...	5.0
20	841	.625	.261	.5500	25.9	28.1	32.4	28.93	+ 5.32	118	117	177	143	83	75	96	88	n e b n	n e b e	n e b e	n 38 e	4.5	14.0	12.4	10.58	14.35	0.070	...
21	.488	.696	.791	.6797	29.7	34.8	29.2	31.35	+ 7.62	150	156	137	148	91	78	84	84	w b n	w	w s w	s 72 w	15.0	3.5	11.5	6.40	7.69	...	...
22	.779	.686	—	—	32.1	34.6	—	—	—	172	133	—	—	95	67	—	—	s s w	s b w	s w b s	s 30 w	10.6	14.8	14.0	12.48	12.63	...	...
23	.494	.459	.556	.5000	33.2	39.3	31.3	35.98	+12.05	182	190	161	179	96	80	92	86	s b w	s w b s	Calm.	s 41 w	11.7	4.4	0.0	4.94	5.23	...	...
24	.514	.218	.171	.2930	35.3	44.8	44.1	42.77	+18 63	183	184	267	219	89	63	94	80	s w	e b s	s s w	s 37 w	3.2	7.0	10.0	8.15	10.30	0.035	...
25	.435	.563	.771	.6188	37.1	40.0	29.4	33.85	+ 9.52	207	156	111	155	95	63	67	78	w b s	w	w b n	n 85 w	12.6	21.2	18.0	17.83	18.31	...	...
26	.941	30.061	30.110	30.0452	21.2	25.9	18 0	21.77	— 2 77	105	108	068	088	89	75	66	72	w b n	w n w	n w b n	n 53 w	19.8	21.3	13.5	14.42	15.32	...	0.3
27	30.006	29.768	29 345	29.6762	16.9	25.3	25.9	22.72	— 2.00	084	113	131	106	86	81	92	84	n	s s e	s w b s	s 87 w	4.0	3.6	4.0	3.31	9.21	...	...
28	29.416	29.281	29.360	.3585	17.6	30.6	19.8	22.57	— 2.33	089	103	084	088	88	58	75	71	w s w	w	w n w	s 84 w	7.5	31.0	9.0	11.02	12.22	...	...
M	29.7603	29.7433	29.7074	29.7361	25.28	31.41	28.63	28.53	+ 4.86	.142	.149	.151	.147	.91	.77	.85	.84	....	....	....	....	9.44	11.38	8.25	......	9.82	3.050	11.7

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR FEBRUARY.

Highest Barometer........................ 30.361 at 9 p. m., on 10th } Monthly range= 1.209
Lowest Barometer .... 29.152 at 4 p. m., on 24th }

Self-regist'ing Thermom.
- Maximum Temperature..............52.°4 on p. m., of 17th } Monthly range= 58.°3
- Minimum Temperature..............−5.°9 on p. m. of 2nd }
- Mean maximum Temperature .... 35°66 } Mean daily range= 15.25
- Mean minimum Temperature .... 20°42 }
- Greatest daily range ....32°0 from a. m. of 3rd to a. m. of 4th.
- Least daily range.................. 4.0 from p. m. of 22nd to a. m. of 23rd

Warmest day......... 7th ... Mean temperature......... 47°08 } Difference = 43°36.
Coldest day........... 2nd ... Mean temperature......... 3.72 }

Maximum. { Solar...................................... 68°5 on p. m. 17th } Monthly range= 83°0
Radiation. { Terrestrial................................ —14°5 on p. m. 2nd }

Aurora observed on 1 night, viz., 26th.
Possible to see Aurora on 12 nights; impossible on 16 nights.

Snowing on 11 days.—depth 11.7 inches ; duration of fall 34.3 hours.
Raining on 11 days,—depth 3.050 inches ; duration of fall 73.1 hours.

Mean of cloudiness = 0.72.
Most cloudy hour observed, 8 a. m., mean = 0.79; least cloudy hour observed, 10 p. m., mean, =0.61.

Sums of the components of the Atmospheric Current, expressed in miles,

North.	South.	East.	West.
1543.50	2055.24	1177.46	3594.40

Resultant direction S. 78° W. ; Resultant Velocity 3.68 miles per hour.
Mean velocity........................... 9.82 miles per hour.
Maximum velocity .... 44.6 miles from 6 to 7 a. m. on the 10th.
Most windy day....................... 10th ...Mean velocity 20.57 miles per hour.
Least windy day .... 16th...Mean velocity 1.11 ditto.
Most windy hour ... noon to 1 p. m.......Mean velocity 12.68 ditto. } Difference
Least windy hour ... 11 p. m. to midnight.Mean velocity 7.84 ditto. } 4.84 miles.

7th—Halo round the Moon, at 10 p. m.
9th—Halo round the Moon, from 10 p. m.
13th—Halo and Corona round the Moon, from 11.30 p. m.
15th, 16th, and 17th—Very foggy and mild.
18th—Thunder and Lightning from 9 p.m., (first of the season,) accompanied with rain, hail, sleet, and snow.
24th—Sheet-lightning at 7.35 p. m.
26th—Faint auroral light from 7 to 8 p. m.
28th—Halo round the Moon, from 7.15 to 8.30 p. m. Brilliant meteor in W. at 11.40 p. m., moving horizontally towards the north; tail emitting sparks.

This was the warmest February on our records, having a mean temperature 5.55 above the average of 18 years, 13.1 above the mean temperature of February 1855, and 12.8 above that of February 1856.

The observed maximum 51.2 was higher than any previously recorded in February.

The number of days on which rain fell was greater than on any former occasion, and the depth was 1.911 inches above the average. This was the most rainy February on record excepting that of 1842.

The resultant direction of the wind for February, from 1848 to 1857, inclusive, was N 70° W, and the resultant velocity 2.93 miles per hour.

COMPARATIVE TABLE FOR FEBRUARY.

Year.	Temperature.					Rain.		Snow.		Wind.		
	M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range.	No. of days.	Inch's.	No. of days.	Inch's.	Resultant. Direction.	Resultant. V'y.	Mean Force or Velocity.
1840	28.0°	+5.0°	49.1°	−8.3°	57.4°	8	1.475	6	Not re gist'd	...	...	....
1841	22.4	−0.6	43.4	−0.3	43.7	1	0.000	9		...	...	0.61 lbs.
1842	26.9	+3.9	48.7	+2.5	46.2	8	3.625	9		...	...	1.03
1843	14.5	−8.5	37.5	−10.2	47.7	1	0.475	21	14.4	...	...	1.05
1844	26.0	+3.0	47.1	−0.4	47.5	4	0.430	7	10.0	...	...	0.43
1845	26.0	+3.0	46.6	−3.9	50.5	5	imper	9	19.0	...	...	0.99
1846	20.4	−2.6	41.4	−16.2	57.6	0	0.000	13	46.1	...	...	0.65
1847	21.5	−1.5	42.2	−1.0	43.2	2	0.550	13	27.3	...	...	0.69
1848	26.6	+3.6	46.9	−0.6	47.5	4	0.775	8	10.8	N 65° W	2.53	5.69 miles
1849	19.5	−3.5	41.1	−9.2	50.3	2	0.240	13	19.2	N 41° W	1.48	6.58
1850	26.0	+3.0	49.2	+1.3	47.9	7	1.235	9	23.1	N 80° W	3.43	7.61
1851	27.6	+4.6	50.2	+1.3	48.9	7	2.600	4	2.4	N 64° W	1.99	6.94
1852	23.4	+0.4	41.2	−3.2	44.4	3	0.650	11	13.0	S 75° W	3.34	6.42
1853	24.1	+1.1	43.4	−0.6	44.0	4	1.030	15	12.6	N 49° W	2.51	7.29
1854	21.1	−1.9	42.7	−5.7	48.4	5	1.460	15	18.0	N 7° E	1.68	6.91
1855	15.4	−7.6	37.3	−25.0	62.3	2	1.770	14	21.8	N 39° W	4.33	8.17
1856	15.7	−7.3	35.3	−18.7	54.0	0	0.000	8	9.7	N 81° W	7.70	10.71
1857	28.5	+5.5	51.2	−5.9	57.1	11	3.050	11	11.7	S 78° W	3.68	9.82
M	22.98	...	44.14	−5.78	49.92	4.1	1.139	10.8	17.27			7·61 miles

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—MARCH, 1857.

Latitude—43 *deg.* 39.4 *min. North. Longitude*—79 *deg.* 21 *min. West. Elevation above Lake Ontario*, 108 *feet.*

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Mean Temp. + or — of the Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN	6 A.M	2 P.M	10 P.M	ME'N		6 A.M	2 P.M	10 P.M	M'N	6 A.M	2 P.M	10 P.M	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M	2 P.M	10 P.M	Result.	ME'N		
					°	°	°	°	°												°							
1	29.234	29.115	—	—	15.8	23.8	—	—	—	.090	.115	—	—	.95	.87	—	—	Calm.	N E	N W	N 25 W	0.0	12.0	22.5	13.28	16.22	...	2.5
2	.759	.835	29.848	29.8343	-3.7	7.5	-0.4	1.10	—24.32	.039	.050	.014	.045	.97	.75	.95	.90	N Wb N	NW bN	N WbN	N 42 W	24.6	14.9	6.0	11.58	11.64	...	...
3	.738	.522	.490	.5703	-3.1	22.7	25.0	16.48	— 9.23	.039	.091	.109	.084	.93	.73	.79	.81	N WbN	SW b S	SW b W	S 51 W	1.5	15.2	11.0	11.10	12.00	...	0.2
4	.541	.611	.589	.5893	23.8	31.0	30.3	28.08	+ 2.08	.104	.100	.137	.113	.78	.57	.81	.73	W N W	S	S S E	S 12 E	8.0	9.0	6.0	4.02	9.75	...	0.2
5	.393	.305	.312	.3393	30.6	37.0	33.9	31.22	+ 8.02	.149	.179	.174	.172	.88	.81	.90	.87	S S E	S b W	W N W	S 75 W	12.0	13.4	11.1	6.39	12.79	...	0.2
6	.373	.335	.488	.4107	18.0	23.8	13.0	17.53	— 8.97	.096	.058	.066	.070	.94	.44	.80	.71	W N W	W	W N W	N 75 W	22.8	30.0	27.0	23.23	23.76	...	...
7	.685	.789	.862	.7913	7.1	16.6	11.5	12.25	—14.57	.060	.082	.062	.062	.92	.84	.79	.77	W b N	W N W	W b N	N 74 W	16.0	25.5	0.8	12.18	12.37	...	...
8	.897	.902	—	—	5.3	22.3	—	—	—	.054	.082	—	—	.85	.66	—	—	Calm.	S	S b W	S 15 W	0.0	16.0	3.5	6.79	7.22	...	1.9
9	.420	.195	.527	.3835	23.9	29.9	13.7	21.22	— 6.30	.129	.148	.070	.106	.92	.89	.81	.86	S E.	S E	W N W	N 61 W	7.2	5.2	23.5	13.20	16.23	...	2.2
10	.667	.633	.649	.6548	1.2	19.4	14.4	11.15	—16.68	.048	.093	.071	.070	.95	.85	.80	.87	W b N	SW b W	SW b W	S 58 W	11.0	11.4	4.8	6.19	6.88	...	Inap
11	.626	.577	727	.6443	13.3	27.2	15.3	18.33	— 9.98	.069	.105	.067	.078	.81	.70	.73	.74	Calm.	Calm,	NWbW	N 68 W	0.0	0.0	10.5	6.05	7.02	...	0.1
12	842	.906	.996	.9255	3.5	21.2	12.0	13.35	—15.20	.045	.059	.063	.059	.80	.51	.79	.71	W	W b N	W b S	W	9.2	14.5	4.8	9.55	10.67	...	...
13	.976	.829	.651	.8042	10.4	31.0	28.8	24.83	— 4.13	.063	.109	.100	.096	.83	.63	.63	.70	W b S	S S W	S W b S	S 31 W	5.3	13.4	0.2	7.35	7.56	...	...
14	.515	.516	.667	.5722	30.1	37.5	27.0	31.58	+ 2.27	.109	.128	.134	.123	.65	.57	.89	.71	SW b W	W b S	NWbW	N 83 W	4.9	13.5	5.5	7.39	7.96	...	...
15	.755	.720	—	—	16.7	31.5	—	—	—	.062	.117	—	—	63	.66	—	—	Calm.	S E	Calm.	S 18 E	0.0	5.5	0.0	0.92	1.30	...	..
16	.551	.486	.515	.5182	28.9	34.2	32.6	31.68	+ 1.65	.145	.162	.155	.154	.91	.82	.84	.86	Calm.	W	W S W	S 48 W	0.0	9.0	0.8	2.82	3.07	...	...
17	.591	.640	.636	.6270	28.8	37.7	32.4	33.72	+ 3.27	.146	.130	.171	.153	.92	.57	.94	.80	Calm.	S b W	E S E	S 61 E	0.0	7.0	6.2	3.02	5.57	0.145	0.5
18	.439	.325	.403	.3798	33.5	40.0	38.9	37.37	+ 6.52	.185	.206	.179	.194	.97	.84	.76	.87	E b N	Calm.	NW bN	N 9 W	7.5	0.0	2.8	3.70	5.98	0.090	Inap
19	.418	.222	.329	.3110	29.2	24.1	32.1	28.88	— 2.38	.150	.132	.133	.141	.94	.100	.73	.89	N N W	NW bN	NW bN	N 35 W	17.4	32.7	20.2	23.01	23.35	...	3.0
20	.464	.500	.486	.4725	24.9	35.7	32.8	31.55	— 0.12	.104	.144	.160	.135	.76	.70	.86	.76	W N W	S b W	S E	S 65 E	7.0	8.2	5.4	2.01	8.83	...	0.2
21	.342	.603	.790	.6003	31.5	40.7	36.8	36.73	+ 4.65	.164	.159	.134	.153	.94	.63	.62	.72	E N E	W	W b N	N 86 W	2.0	32.5	9.5	12.98	13.22	...	0.2
22	30.000	29.992	—	—	30.3	38.9	—	—	—	.148	.165	—	—	.88	.70	—	—	Calm.	E S E	E b N	N 81 E	0.0	1.0	17.5	8.64	9.06	Inap	...
23	.532	.443	.660	.5510	36.4	56.5	39.7	44.13	+11.35	.147	.220	.210	.195	.69	.49	.87	.70	E	W	W S W	N 74 W	15.6	26.0	0.8	4.50	7.17	...	...
24	.606	.481	.482	.5145	35.3	37.5	37.1	36.33	+ 3.17	.201	.194	.184	.191	.98	.87	.84	.90	Calm.	N b W	W b S	N 81 W	0.0	1.0	13.0	4.04	5.18	0.100	...
25	.465	.536	.602	.5398	32.4	31.0	31.3	30.92	— 2.65	.169	.119	.122	.134	.93	.68	.70	.77	W b N	NWbW	N W	N 46 W	12.5	26.0	27.5	20.66	21.10	...	0.1
26	.631	.637	.676	.6528	27.7	37.3	31.0	32.20	— 1.78	.120	.122	.153	.131	.78	.56	.88	.73	NW b N	NW bN	N W	N 36 W	22.0	18.0	0.4	12.64	12.79	...	...
27	.646	.602	.624	.6235	29.5	39.3	33.7	34.60	+ 0.18	.133	.141	.125	.138	.81	.58	.64	.70	NW b W	NW bN	N W	N 41 W	3.3	10.5	9.0	9.61	9.71	...	...
28	.610	.621	.682	.6395	33.2	41.5	35.1	36.58	— 1.87	.155	.128	.130	.137	.81	.48	.63	.64	NW bN	N bW	NW bN	N 23 W	7.0	19.0	8.8	12.20	12.37	...	...
29	.730	.762	—	—	33.2	41.6	—	—	—	.155	.123	—	—	.81	.48	—	—	N W	N bW	NW bN	N 30 W	10.6	13.4	15.5	13.44	13.59	...	...
30	.893	.881	.873	.8828	32.1	48.3	36.3	38.73	+ 3.23	.137	.116	.112	.120	.76	.34	.52	.54	NW b N	N bW	N N W	......	...	...	...	...	...	...	...
31	.847	.678	.494	.6560	29.5	48.9	38.2	39.73	+ 3.82	.133	.151	.173	.161	.81	.44	.75	.67	Calm.	SW b S	Calm.	......	...	...	...	...	...	...	...
M	29.5988	29.5657	29.6176	29.5957	22.62	32.98	27.40	27.82	— 2.56	.117	.128	.125	.124	.86	.67	.78	.77	......	......	......	......	7.84	13.92	9.47	...	10.84	0.335	11.3

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR MARCH, 1857.

Highest Barometer . . . . 30.006 at midnight on 12th } Monthly range=
Lowest Barometer . . . . 29.115 at 2 p. m. on 1st } 0·891 inches.

Self-registering Ther.
- Maximum temperature . . . . 57°6 on p. m. of 23rd } Monthly range=
- Minimum temperature . . . . —5.5 on a. m. of 2nd } 63°1
- Mean maximum temperature . . 35°25 } Mean daily range = 17°46
- Mean minimum temperature . . 17°79 }
- Greatest daily range . . . . 37°0 from p. m. of 1st to a. m. of 2nd.
- Least daily range . . . . 6°0 from p. m. of 24th to a. m. of 25th.

Warmest day . . 23rd ... Mean Temperature . . . 44°13 } Difference=43°03.
Coldest day . . . . 2nd ... Mean Temperature . . . 1°10 }

Maximum. Solar, ... 68°8 on p. m. of 23rd } Monthly range=
Radiation. Terrestrial . . . . —11°5 on a. m. of 2nd } 80°3

Aurora observed on 2 nights, viz.: 16th and 17th; possible to see Aurora on 13 nights; impossible to see Aurora on 18 nights.

Snowing on 15 days; depth, 11.3 inches; duration of fall, 48.6 hours.

Raining on 4 days; depth, 0.335 inches; duration of fall, 11.1 hours.

Mean of cloudiness=0.61; most cloudy hour observed, 6 a. m., mean=0.66: least cloudy hour observed, 10 p. m.; mean=0.52.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
3225.85	1133.55	638 35	4751.59

Resultant direction of the wind, N 63° W; Resultant Velocity, 6.63 miles per hour.

Mean velocity of the wind 10.84 miles per hour.
Maximum velocity . . . 36.5 miles per hour, from noon to 1 p. m. of 19th.

Most windy day . . . . 6th—Mean velocity, 23.76 miles per hour.
Least windy day . . . . . . 15th—Mean velocity, 1.30 do

Most windy hour 4 to 5 p. m.—Mean velocity, 14·55 do } Difference
Least windy hour 6 to 7 a. m.—Mean velocity, 8.16 do } 6.39 miles.

3rd—Faint halo round the Sun at 2 p. m. Perfect halo round the Moon during the evening.
5th—Perfect halo round the Moon, 7 to 8 p. m.
6th—Perfect halo round the Moon from 9 p. m
8th—Halo round the Moon at 9 p. m.
10th—Corona round the Moon from 10 p. m.
14th—Halo round the Moon 0.30 a. m.
15th—Halo round the Sun at 9 a. m.
17th—Perfect halo and faint Parhelia at 4.50 p. m. Splendid meteor in N. at 8.30 p. m.
22nd—Perfect halo and Parhelia at 0.45 p. m. Sheet-lightning in W. and S. W. at 10 p. m.
31st—Perfect solar halo and Parhelia at 9.30 a. m.

The mean temperature of the month was 2° lower than that of the average of the last 18 years.
The depth of Rain was less than one quarter of its average amount.
The resultant direction of the wind from 1848 to 1857, for the month of March, was N 58° W, and the resultant velocity 3.19 miles per hour.
The velocity, &c., of the wind for the last two days of the month were imperfect—the anemometer having been dismounted for repair.

COMPARATIVE TABLE FOR MARCH.

YEAR.	Temperature: Mean.	Temperature: Difference from Average.	Temperature: Maximum observed.	Temperature: Minimum observed.	Temperature: Range.	Rain: No. of days.	Rain: Inches.	Snow: No. of days.	Snow: Inches.	Wind: Resultant Direction.	Wind: Resultant Velocity.	Wind: Mean Velocity
1840	33.3	+ 3.5	56.9	8.7	48.2	8	1.640	8	Not registered	—	—	—
1841	27.7	— 2.1	53.5	— 6.9	60.4	5	1.170	7		—	—	0.51 lbs.
1842	35.8	+ 6.0	68.7	14.9	53 8	4	3.150	8		—	—	0.70 "
1843	21.3	— 8.5	38.6	— 2.8	41.4	2	0.625	18	25.7	—	—	1.18 "
1844	31.3	+ 1.5	50.3	9.6	40.7	8	2.470	8	14.0	—	—	0.57 "
1845	35.4	+ 5.6	61.7	9.9	51.8	5	Impft	8	2.8	—	—	0.66 "
1846	33.1	+ 3 3	49 3	7.6	41.7	9	1.965	5	2.3	—	—	0.30 "
1847	26.2	— 3.6	44.3	4.8	39.5	5	0.850	6	4.2	—	—	0.71 "
1848	28.6	— 1.2	58.9	0.9	58.0	5	1.220	6	9.7	N 66 W	2.03	5·80 mls.
1849	33.5	+ 3.7	53.4	15.4	38.0	7	1.525	2	2.3	N 3 W	1.48	5.37 "
1850	29.8	0.0	46.0	6.0	40.0	2	0.745	7	11.2	N 53 W	2.62	7.62 "
1851	32.4	+ 2.6	58.7	13.1	45.6	3	0.770	9	8.8	N 21 W	1.93	7.65 "
1852	27.7	— 2.1	44.8	— 3.2	48.0	8	3.080	12	19.5	N 7 W	0.71	5.81 "
1853	30.6	+ 0.8	56.3	— 0.1	56.4	6	1.080	8	7.1	N 62 W	2.56	5.87 "
1854	30.7	+ 0 9	52.8	10.4	42.4	9	2.425	3	2.8	N 50 W	3.25	8.02 "
1855	28.5	— 1.3	48.6	— 2.9	51.5	5	1.485	11	18.1	N 72 W	4.99	9.95 "
1856	23.1	— 6.7	39.3	—13.6	52.9	0	0.000	12	16.2	N 71 W	7.68	11.39 "
1857	27.8	— 2.0	56.5	— 3.9	60.4	4	0.335	15	11.3	N 63 W	6.63	10.84 "
Mean	29.82	...	52.14	3.77	48.37	5.3	1.443	8.5	10 40	—	—	7.83

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—FEBRUARY, 1857.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32° 6 A.M.	2 P.M.	10 P.M.	Temp. of the Air. 6 A.M.	2 P.M.	10 P.M.	Tension of Vapor. 6 A.M.	2 P.M.	10 P.M.	Humidity of Air. 6 A.M.	2 P.M.	10 P.M.	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Velocity in miles per hour. 6 A.M.	2 P.M.	10 P.M.	Mean direction of Wind.	Rain in Inches.	Snow in Inches.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0. 6 A.M.	2 P.M.	10 P.M.
1	29.581	29.655	29.721	7.9	20.1	12.3	.063	.105	.078	.84	.82	.90	w s w	w by s	w b s	19.85	13.28	5.02	...	...	...	C. C. Str. 5.	Cir. Str 10.	C. Str. 10.
2	.716	.717	.925	6.5	14.3	—1.5	.059	.076	.040	.90	.84	.83	w by s	w by N	N w	12.22	6.82	1.9	...	...	...	C. Str. 8.	Do. 4.	Clear.
3	30.229	30.213	30.069	—4.3	13.9	6.2	.038	.083	.057	.84	.64	.79	w N w	s by w	s E b E	6.13	0.38	2.22	...	...	Inp	Light Cir. 2.	Clear.	C. Str. 10.
4	29.729	.146	.214	6.7	24.2	12.5	.059	.115	.083	.90	.76	.82	N E	N E b E	N b E	8.81	0.40	2.23	...	...	0.41	Snow.	Snow.	Do. 10.
5	30.289	.079	29.860	9.1	14.3	26.5	.082	.091	.147	.83	.87	.90	E b N	N E b E	N E b E	12.51	9.37	2.62	...	...	1.70	Cir. Str. 10.	Snow.	Rain.
6	29.961	29.986	30.033	27.6	45.5	35.1	.144	.303	.186	.83	.89	.84	s b w	N w	E b N	6.06	1.22	0.30	...	.140	...	Do. 8.	C. C. Str. 9.	C. C. S. 6. L.H
7	.916	.945	29.885	33.4	50.8	40.9	.169	.337	.253	.82	.87	.92	s s E	SE by s	s E	2.62	13.63	8.16	...	...	...	C. C. Str. 8.	Cir. Str. 4.	Do. 6.
8	.616	.636	.910	39.1	45.1	30.9	.224	.282	.171	.89	.87	.89	s E	s w	w b s	17.53	10.93	17.55	...	.890	Inp	Do. 6.	Cir. Str. 10.	C. C. Str. 4.
9	30.255	30.309	30.345	7.0	13.6	10.1	.061	.074	.066	.88	.83	.87	N w	w N w	s	17.06	7.30	3.41	...	...	...	Clear.	Clear.	Clr. Zod. Lgt.
10	29.881	29.892	30.388	9.6	20.0	—7.5	.067	.113	.026	.90	.87	.86	s s E	w by N	w b N	10.31	9.53	4.83	...	...	0.05	Cir. Str. 10.	Cir. Str. 6.	Do. do. do.
11	30.486	30.455	.603	—11.9	—5.0	—11.9	.021	.031	.021	.75	.82	.73	w N w	w	w N w	2 70	8.60	9.91	...	...	...	Clear.	Light Cir. 4.	Do. do. do.
12	.762	.569	.439	—19.9	11.7	2.1	.016	.068	.042	.80	.82	.84	E N E	s E	N E b E	1.32	5.86	4.80	...	...	...	Do.	C. C. Str. 6.	Do. do. do.
13	29.825	29.763	29.941	11.1	38.4	33.6	.101	.207	.193	.96	.87	.91	s s E	s w	w b N	12.63	6.35	13.17	...	...	Inp	Cir. Str. 10.	Snow.	Cir. Str. 10.
14	.358	.207	.856	12.0	17.3	11.7	.081	.084	.066	.84	.73	.76	E N E	NE b E	NE b E	14.32	6.53	8.63	...	...	...	C. C. Str. 2.	C. C. Str. 4.	Do. 4.
15	.725	.795	.863	38.0	46 1	36.4	.217	.282	.200	.90	.86	.90	s w b w	s w b w	E N E	8.60	1.35	0.01	...	.040	...	Cir. Str. 10.	C. Str. 10,	Fog.
16	.750	.779	.785	34.5	35.5	35.5	.203	.210	.187	.91	.90	.89	NE by E	NE b E	N E	0 63	1.50	0.22	...	.959	...	Rain.	Do. 10.	Rain.
17	.855	.615	.597	32.5	36.7	31.5	.182	.218	.182	91	.90	.91	s s w	NE by E	N b w	1.01	0.01	0.01	...	.047	...	Cir. Str. 7.	Fog.	Do.
18	.780	.862	.983	30.0	36.0	27.8	.171	.199	144	.90	.87	.88	w by N	N E b N	s E b E	3.00	4.90	4.65	...	...	...	Do. 10.	Cir. 2.	C. Str. 10.
19	.905	.956	30.185	17.4	24.0	15.6	.106	.140	.098	.87	.80	.88	NE by E	N E	N E b E	31.72	15.75	5.33	...	...	2.60	Snow.	C. C. Str. 8.	Clr. Zod. Lgt.
20	30.202	30.030	29.908	4.8	26.8	17.0	.051	.104	.096	.85	.74	.83	N E	N E b E	N E b E	17.80	10.20	8.37	...	...	...	Clear.	C. Str. 10.	Snow.
21	27.537	29.604	29.902	15.9	28.4	23.6	.087	.161	.144	.78	.89	.90	NE b E	w by N	s w	1.47	8.70	9.70	...	...	8 45	Snow.	Do. 10.	Clr. Zod. Lgt.
22	.883	.782	.752	24.4	41.0	33.0	.123	.240	.187	.79	.87	.90	sw b w	sw b w	sw b w	5.87	6.81	12.08	...	...	...	C. C. Str. 4.	Do. 10.	Cir. Str. 10.
23	.605	.562	.757	29.9	42.0	33.5	.152	.225	.175	.82	.79	.91	sw b w	swb w	sw b w	14.99	9.01	0.62	...	...	...	Cir. Str. 10.	Do. 10.	Do. 10.
24	.740	.588	.317	35.0	50.0	40.5	.199	.304	.227	.89	.80	.85	s s E	s	s w b N	1.98	0.00	0.20	...	Inp	...	Do. 2.	Rain.	S. W. Rain.
25	.370	.434	.697	41.6	42.9	30.1	.243	.233	.160	.85	.79	.86	w s w	w s w	NW b N	26.61	15.82	18.00	...	...	...	Cir. Str. 4	C. Str. 6.	Clr. Zod. Lgt.
26	.958	30.114	30.257	13.5	12.1	5.7	.075	.070	.058	.80	.73	.89	N w	N w	N w	24.07	11.33	18.70	...	...	...	Str. 4.	Clear.	Do. Aur. Bor.
27	30.255	.001	29.764	—1.0	16.5	12.3	.043	.096	.083	.87	.83	.83	N E b N	sw b s	s E b E	18.70	11.87	1.36	...	...	...	Clear.	Do.	C. C. Str. 10
28	.378	.374	30.541	9.4	22.5	9.6	.079	.115	.079	.88	.82	.89	s w	w by N	NW b w	6.70	15.70	10.02	...	...	1.80	C. St. 10.	Cir. Str. 4.	C. Str. 4. A. B.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—MARCH, 1857.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL. D.

Latitude—45 deg. 32 min. North. Longitude—73 deg, 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32° Fahr.			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Velocity in miles per hour.			Mean direction of Wind.	Rain in Inches.	Snow in Inches.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A. M.	2 P. M.	10 P. M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 PM	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M	10 PM				6 A. M.	2 P. M.	10 P. M.
1	29.496	29.570	29.664	4.4	23.1	9.0	.051	.095	.069	.86	.64	.90	S E	S E	N E by E	0.63	1.86	1.56	...	...	...	Cir. Str. 4.	C.St.10 S.H	Clear Aur. Bor.
2	.801	.837	.883	2.0	17.0	6.8	.046	.089	.052	.83	.85	.80	N N E	N E by E	N N W	13.02	8.12	8.80	...	...	...	Cir. Cum. Str. 4	Clear.	Do.
3	.827	.701	.685	−3.0	16.0	16.7	.041	.084	.090	.91	.84	.90	W S W	W	S W	7.10	2.33	7.90	...	...	...	Clear.	Do.	Cir. Cum. Str. 10.
4	.717	.749	.857	19.3	26.4	22.8	.121	.119	.112	.91	.71	.77	S by W	S by W	S by W	4.77	0.33	1.51	...	...	Inp	Snow.	Cir. Cm. Str. 4.	Cir. Str. 10.
5	.871	.716	.660	10.0	39.0	33.7	.079	.214	.179	.88	.84	.85	E by N	S S E	S S E	1.02	7.03	13.60	...	...	...	Hoarfrost.	Cir. Str. 10.	Do. 10.
6	.270	.610	.377	31.1	26.2	14.1	.171	.112	.066	.89	.70	.76	S S E	W N W	N by W	0.11	13.07	14.25	...	...	2.94	Snow.	Snow.	Cir. Cum. Str. 10.
7	.562	.820	.932	2.0	20.1	2.1	.042	.114	.042	.76	.74	.76	W	W by N	W S W	20.60	19.93	7.22	...	...	...	Cir. Str. 10.	Cir. 2.	Clear.
8	30.188	30.160	30.120	−5.0	19.5	5.7	.031	.103	.058	.82	.80	.87	W by S	S W	S	0.46	2.36	1.42	...	...	...	Clear.	Clear.	Do.
9	29.894	29.550	29.412	5.0	28.0	23.6	.053	.135	.135	.89	.82	.90	N E b E	S by E	S by E	3.31	5.42	9.31	...	...	4.72	Cir. Str. 10.	Snow.	Snow.
10	.629	.746	.860	6.2	26.1	1.3	.058	.147	.041	.92	.90	.83	W N W	W	W	16.73	10.11	14.00	...	...	...	Cir. Str. 4.	Clear.	Clear.
11	.945	.912	.802	−11.4	25.7	6.2	.021	.118	.053	.80	.87	.88	N E b N	N E by E	E N E	0.37	1.51	1.48	...	...	...	Cir. Cm. St. 2.	C. C. Str. 6.	Cir. Cum. Str. 6.
12	.809	.879	30.123	0.0	17 5	−1.0	.037	.089	.038	.78	.85	.83	W	N W b W	S S E	5.76	8.51	12 03	...	...	...	Cir. Str. 8.	Cir. Str. 10.	Clear.
13	30.105	30.049	29.858	−6.0	33.0	15.6	.031	187	.098	.81	.90	.88	S W	S W	S	9 12	0.77	3.71	...	...	...	Clear.	C. C. Str. 8.	Clear Zod. Lght.
14	29.641	29.610	.715	13.3	37.0	25.1	.073	.199	.123	.78	.83	.80	W by S	W N W	N W b N	2.83	7.00	11.17	...	...	...	Do.	Cir. Str. 10.	Do. do.
15	.910	.994	.897	8.7	38.9	23.0	.059	.214	.093	.88	.84	.70	S W b S	S W	S b W	0.90	6.90	2.08	...	...	...	Do.	Clear.	Do. do.
16	.762	.688	.641	21.3	36.1	30.1	.108	.210	.160	.77	.91	.86	E	E by N	N	0.00	2.26	1.15	...	...	...	Cir. Cm. St. 10.	Cir. Str. 10.	Sleet.
17	.667	.805	.907	29.0	36.6	26.0	.152	.199	.118	.85	.83	.73	W	W by N	N E b N	8.61	10.92	1.47	...	...	0.61	Cir. Str. 10.	Do. 6.	Clear Aur. Bor.
18	.891	.585	.646	15.9	33.2	32.3	.081	.187	.187	.74	.90	.86	E by N	N E by E	E b N	6.60	11.02	0.10	...	Inapp	...	Do. 8.	Rain.	Cum. Str. 10.
19	.535	.336	.243	30.4	33.4	27.1	.182	.187	.137	.91	.90	.82	N E by E	N E by E	N E b E	13.00	44.36	40.00	...	0.726	...	Do. 10.	Cir. Str. 10	Do. 10.
20	.390	.561	.610	27.2	32.1	24.1	.146	.191	.108	.88	.85	.80	N E by E	N E by E	N E b E	26.10	3.46	1.06	...	...	...	Do. 10.	Do. 10.	Do. 4.
21	.680	.614	.750	19.0	26.7	25.5	.110	.129	.129	.88	.80	.82	N E by E	N E by E	W b S	2.36	2.81	17.78	...	...	4.74	Do. 8.	Snow.	Snow.
22	30.100	30.186	30.241	20.1	43.5	29.2	.089	.252	.152	.70	.85	.85	W by S	E S E	E b S	11.08	0.21	0.85	...	...	...	Clear.	Light Cir. 3.	Clear Aur. Bor
23	29.993	29.794	29.740	22.0	34.6	32.9	.115	.186	.178	.82	.83	.86	N E by E	S E	W b N	4.14	8.63	8.26	...	...	...	Cir. Str. 10.	Sleet.	Cum. Str. 10.
24	.724	.646	.546	34.7	48.6	36.2	.186	.261	.210	.83	.74	.91	W S W	S by E	S W b S	2.17	2.20	1.82	...	Inapp	...	Do. 10.	Cir. Str, 10.	Rain.
25	.400	.403	.521	32.7	34.7	29.5	.189	.178	.160	.92	.83	.86	W by N	W by N	W b N	3.56	13.55	14.30	...	...	1.20	Do. 5.	Do, 8.	Cir. Str. 10.
26	.546	.596	.671	23.1	39.0	33.2	.135	.214	.170	.78	.84	.85	W by N	W S W	W b N	8.01	11.80	9.05	...	...	...	Do. 8.	Do. 4.	Do. 4.
27	.614	.599	.651	30.7	41.8	35.0	.152	.217	.191	.79	.99	.85	W S W	S W b W	W b N	12.42	8.78	8.73	...	...	Inp	Snow.	Do. 8.	Do. 10.
28	.639	.640	.687	32.9	41.1	35.3	.178	.191	.170	.86	.70	.76	W S W	W by N	W b N	6.42	3.70	9.13	...	...	...	Cir. Str. 9.	Do. 8.	Do. 8.
29	.731	.740	.812	34.3	46.9	36.6	.191	.234	.192	.85	.69	.83	W by N	S S W	S E b E	10.28	1.77	0.10	...	...	...	Do. 8.	Do. 2.	Do. 7.
30	.890	.914	.938	29.9	47.1	36.3	.160	.252	.192	.86	.74	.82	W S W	W by N	W b N	2.37	6.34	3.50	...	...	...	Clear.	C.C. Str. 2.	Clear.
31	.880	.775	.642	33.0	51.6	38.2	.178	.274	.189	.86	.70	.79	W	S W b W	S W b W	1.06	1.77	9 22	...	...	...	Do.	Do. 4.	Cir. Str. 10.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR FEBRUARY.

Barometer	Highest, the 12th day	30.762
	Lowest, the 14th	29.207
	Monthly Mean	29.915
	Monthly Range	1.555
Thermometer	Highest, the 15th day	46°.1
	Lowest, the 12th day	—20.1
	Monthly Mean	21°61
	Monthly Range	66.2
Greatest intensity of the Sun's Rays		89°.7
Lowest point of Terrestial Radiation		—21.7
Mean of Humidity		.850

Rain fell on 6 days amounting to 2.074 inches ; it was raining 36 hours 40 minutes.

Snow fell on 9 days, amounting to 15.11 inches ; it was snowing 42 hours 30 minutes.

The most prevalent wind was the N E by E.

The least prevalent wind S E by S.

The most windy day the 27th ; mean miles per hour 18.03.

Least windy day the 17th ; mean miles per hour 0.34.

The Aurora Borealis visible on 4 nights.

Lunar Halo on the 6th day.

Zodiacal Light bright during the month.

The electrical state of the Atmosphere has indicated rather high and constant Tension.

Ozone was in moderate quantity.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR MARCH.

Barometer	Highest the 22nd day	30.241
	Lowest the 19th day	29.243
	Monthly Mean	29.718
	Monthly Range	0.998
Thermometer	Highest the 30th day	54°3
	Lowest the 11th day	—11°.4
	Monthly Mean	23°79
	Monthly Range	65°7
Greatest Intensity of the Sun's Rays		94°7
Lowest Point of Terrestrial Radiation		—12°.9
Mean of Humidity		.826

Rain fell on 3 days, amounting to 0.723 inches ; it was raining 10 hours and 50 minutes.

Snow fell on 9 days, amounting to 17.01 inches ; it was snowing 57 hours 40 minutes.

Most prevalent wind, W by N. Least prevalent wind, E.

Most windy day, the 19th day ; mean miles per hour, 39.12.

Least windy day, the 16th day ; mean miles per hour, 1.13.

Most windy hour, from 6 to 7, P. M., 19th day ; velocity 77.70 miles.

Aurora Borealis visible on 3 nights.

The "Rossignol" first heard the 25th day.

Wild Geese first seen on the 30th day.

The electrical state of the atmosphere has indicated moderate intensity.

Ozone was in m[illegible]rate quantity.

Zodiacal Light very [illegible]ight.

BARETT'S PIPE.

THE CANADIAN JOURNAL.

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NARCOTIC USAGES AND SUPERSTITIONS OF THE OLD AND NEW WORLD.

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Read before the Canadian Institute, 31*st January*, 1857.

In attempting to determine the elements on which to base a system of classification of the diverse types or varieties of man, there are frequently one or two prominent characteristics which, alike among ancient and modern races, appear to supply at least convenient tests of classification, while some are deserving of special consideration as indicators of more comprehensive and far-reaching principles. The ancient epithet "barbarian," had its origin in the recognition of this idea; and we still apply that of "woad-died" to the old Briton as the fittest which our knowledge of him supplies. With the Jew and his semitic congeners, the rite of circumcision is a peculiarly distinctive element of isolation, though carried by Islamism, with the Arabic tongue, far beyond their ethnic pale. Brahminism, Buddhism, Parseeism, Sabaism, Fetisism, and even Thuggism, each suffice to supply some elements of classification. The cannibal New Zealander, the large footed Patagonian, the big lipped Babeen, the flat-headed Chinook, the woolly-haired Negro, the clucking Hottentot, and the boomerang-armed Australian, has each his special feature, or peculiar symbol, more or less fitly assigned to him; and not less, but more distinctly characteristic than any of these

are the scalp war-trophy, and the peace-pipe of the American Indian, —the characteristics not of a tribe, or a nation, but of a whole continent. Of the indigenous uniqueness of the former of these there is no question. It may not be altogether unprofitable to reconsider the purely American origin of the usages connected with the latter, on which doubts have been repeatedly cast, and more especially by recent writers, when considering the inquiry from very diverse points of view.

Among the native products of the American continent, there is none which so strikingly distinguishes it as the tobacco plant, and the purposes to which its leaf is applied; for even were it proved that the use of it as a narcotic, and the practise of smoking its burning leaf, had originated independently in the old world, the sacred institution of the peace-pipe must still remain as the peculiar characteristic of the Red Indian of America. Professor Johnston, in his "Chemistry of Common Life," remarks with reference to this and others of the narcotics peculiar to the new world:—"The Aborigines of Central America rolled up the tobacco leaf, and dreamed away their lives in smoky reveries, ages before Columbus was born, or the colonists of Sir Walter Raleigh brought it within the precincts of the Elizabethean Court. The cocoa leaf, now the comfort and strength of the Peruvian muletero, was chewed as he does it, in far remote times, and among the same mountains, by the Indian natives whose blood he inherits." The former of these narcotics, however, it is scarcely necessary to say, was not confined, within any period known to us, to central America, though its name of tobacco,—derived by some from the Haîtian *tambaku*, and by others from *Tabaco*, a province of Yucatan, where the Spaniards are affirmed to have first met with it,—appears to have been the native term for the pipe, and not for the plant, which was called *kohiba*.

So far as we can now infer from the evidence furnished by native arts and relics connected with the use of the tobacco plant, it seems to have been as familiar to most of the ancient tribes of the north west, and the Aborigines of our Canadian forests, as to those of the American tropics, of which the *Nicotiana Tabacum* is believed to be a native. No such remarkable depositories indeed have been found to the north of the great chain of lakes, as those disclosed to the explorers of the tumuli of "Mound City," in the Scioto valley, Ohio, from a single one of which, nearly two hundred pipes were taken; most of them composed of a hard red porphyritic stone, with their bowls elaborately carved in miniature figures of animals, birds,

reptiles, &c., executed with great skill and fidelity to nature.* But though not found in such numbers, sufficient examples of this class of relics occur within the Canadian frontier to show the contemporaneous practice of the same arts and customs in this northern region, or to prove such an intercourse with the pipe-sculptors of more southern latitudes, as is assumed in the case of the "Mound Builders," by writers to whom any remote and undefined source ever seems more probable than the one under consideration. Among various examples of such Canadian relics in my own possession are two stone pipe-heads found on the shores of Lake Simcoe. One of these, formed of a dark steatite, though imperfect, exhibits in its carving—a lizard climbing up the bowl of the pipe, with the underside of its lower-jaw ingeniously cut into a human countenance peering over the pipe bowl at the face of the smoker—the same curious imitative art of the native sculptor, as those engraved by Messrs. Squire and Davis, from the ancient mounds of the Mississippi valley. The other is decorated with a human head, marked by broad cheek-bones, and large ears, and wearing a flat and slightly projecting head-dress. The material in which the latter is carved is worthy of notice, as suggestive of its pertaining to the locality where it was found. It is a highly silicious limestone, such as abounds on the shores of the neighbouring Lake Couchiching, and which from its great hardness was little likely to be chosen by the pipe sculptor as the material on which to exercise his artistic skill, unless in such a locality as this, where his choice lay between the hard, but close grained limestone, and the still more intractable crystalline rocks of the same region. Canadian examples of pipe-sculpture, in a great variety of forms, executed in the favorite and easily wrought red pipe-stone of the *Coteau des Prairies*, also occur; but these are generally supposed to belong to a more recent period, and differ essentially in their style of art from the pipes of the mound builders, worked in granite, porphyry, and limestone, as well as in the steatites, and other varieties of the more easily wrought stones which admit, like the red pipe stone, of the elaborate carving and high degree of finish most frequently aimed at by them. In addition to those, another class of pipes, of ruder workmanship in clay, and ornamented for the most part, only with incised chevron and other conventional patterns, exhibiting no traces of imitative art, are of frequent occurrence within the Canadian frontiers; and to these I propose to refer more minutely before closing this paper, as objects

* Smithsonian Contributions to Knowledge. Vol. I. p. 152.

possessing some value in relation to the history of the singular native custom for which such implements were constructed, and to its early practice in Europe. Meanwhile it may be noted that the terms existing in the widely diversified native vocabularies are irreconcileable with the idea of the introduction of tobacco among the northern tribes of the American continent as a recently borrowed novelty. We learn from the narative of Father Francisco Creuxio, that the Jesuit missionaries of the 17th century, found tobacco in abundant use among the Indians of Canada. So early as 1629 he describes the Hurons as smoking immoderately the dried leaves and stalks of the nicotian plant commonly called *tobacco* or *petune;* and such was their addiction to the practice that one of their tribes in Upper Canada, received the designation of the *Petunians,* or smokers, from the latter name for the favourite weed.* This term appears to be of Floridian origin, and was perhaps introduced by the missionaries themselves from the southern vocabulary. But the the Chippeway name for tobacco is *asamah,* seemingly, as Dr. O'Meara—now, and for many years resident missionary among the Indians of the Manitouanin Islands,—assures me, a native radical having no other significance or application. So also the Chippeways have the word *butta* to express smoke, as the smoke of a fire; but for tobacco fumes they employ a distinct term: *bucwanay,* literally: "it smokes," the *puckwana* of Longfellow's "Hiawatha." *Pwahgun* is a "tobacco pipe;" and with the peculiar power of compound words and inflection, so remarkable in the languages of tribes so rude as those of the American forests, we have from this root: *nipwahguneka:* "I make pipes," *kipwahguneka:* "thou makest pipes," *pwahgunea:* "he makes pipes, &c.," so also, *nisuggaswa:* "I smoke a pipe." *kisuggaswa:* "thou smokest," *suggaswa:* "he smokes." While therefore, Europe has borrowed the name of the Indian weed from that portion of the new world first visited by its Genoese discoverer, the language of the great Algonquin nation exhibits an ancient and entirely independent northern vocabulary associated with the use of tobacco, betraying none of the traces of compounded descriptive terms so discernible in all those applied to objects of European

*"Ad insaniam quoque adamant Fumum ex siccatis foliis stirpis superiore seculo in galliam illato: (ab eius qui intulit nomine *nicotiam* placuit appellare: núnc *tabacum* seu *petunum* vulgo vocant: atque inde nomen apud Gallos invenit, quæ inter Canadenses populos Natio Petuniorum dicitur) eo, quod cerebri exsiccandi vim miram habet, uti per navigationes Europæi consueverant primum, nunc vel ab eis vél a Canadensibus res translata ad crapulam. Hi certe ne passum quidem progrediantur sine tubo longiusculo, quo ejusmodi fumos hauriunt, ac fere ad temulentiam; pertentant enim cerebrum, ebrietatemque demum inducunt, vini instar." "*Historiæ Canadensis, seu Novæ Franciæ.*" Paris: 1664. Page 76.

origin. The practice of smoking narcotics, is interwoven with all their habits, so that they even reckon time by pipes, using such word sentences as *ningopwahgun*, "I was one pipe [of time] about it".

In the Old World most of the ideas connected with the tobacco pipe are homely and prosaic enough: and though we associate the chibouk with the poetical reveries of the oriental day-dreamer, and the hookah with the pleasant fancies of the Anglo-Indian reposing in the shade of his bungaloose: nevertheless, the tobacco pipe constitutes the peculiar and most characteristic symbol of America, intimately interwoven with the rites and superstitions, and with the relics of ancient customs and historical traditions of the Aborigines of this New World. If Europe borrowed from it the first knowledge of its prized narcotic, the gift was received unaccompanied by any of the sacred or peculiar virtues which the Red Indian still attaches to it as the symbol of hospitality and amicable intercourse; and Longfellow, accordingly, with no less poetic vigor, than fitness, opens his "Song of Hiawatha" with the institution of "the peace-pipe," by the Great Spirit, the master of life. With all the unpoetical associations which are inseparable from the modern uses of the nicotian weed, it required the inspiration of true poetry to redeem it from its base ideal. But this the American poet has accomplished fully, and with the boldest figures. The Master of Life descends on the mountains of the Prairie, breaks a fragment from the red stone of the quarry, and fashioning it with curious art into a figured pipe-head, he fills it with the bark of the red willow, chafes the forest into flame with the tempest of his breath, and kindling it:

> Erect upon the mountains
> Gitche Manito, the mighty,
> Smoked the calumet, the peace-pipe,
> As a signal to the nations.
> And the smoke rose slowly, slowly,
> Through the tranquil air of morning,
> First a single line of darkness,
> Then a denser, bluer vapor,
> Then a snow-white cloud unfolding,
> Like the tree tops of the forest,
> Ever rising, rising, rising,
> Till it touched the top of heaven,
> Till it broke against the heaven
> And rolled onward all around it.

And the tribes of the ancient Aborigines gathering from river, lake, and prairie, assemble at the divine summons, listen to the warnings and promises with which the Great Spirit seeks to guide them;

and this done, and the warriors having buried their war clubs, they smoke their first peace-pipe, and depart:

> While the Master of Life, ascending,
> Through the opening of cloud-curtains,
> Through the doorways of the heaven,
> Vanished from before their faces,
> In the smoke that rolled around him,
> The pukwana of the peace pipe!

It is no mean triumph of the poet thus to redeem from associations, not only prosaic, but even offensive, a custom which so peculiarily pertains to the usages and the rites of this continent from the remotest times of which its historic memorials furnish any trace; and which was no sooner practically introduced to the knowledge of the old world, than that royal pedant, king James, directed against it his world-famous "Counterblast to Tobacco," describing its use as "a custom loathesome to the eye, hateful to the nose, harmful to the brain, dangerous to the lungs, and in the black stinking fume thereof, nearest resembling the horrible stygian smoke of the pit that is bottomless!"

The history of the custom thus dignified by the assaults of royalty, and against certain uses of which the supreme pontiff, Urban, VIII., fulminated the thunders of the church, has attracted considerable attention in modern times on various grounds. In their relations to physiology the use and effects of narcotics claim an important consideration; and the almost universal diffusion of tobacco in modern times, accompanied with its peculiar mode of enjoyment, so generally adopted by the most diverse tribes and nations in every quarter of the globe, give its history a preeminence in any such inquiry. The questions as to whether the practice of smoking narcotics, or even the use and peculiar properties of tobacco, were known to the old world prior to the discovery of America, have accordingly repeatedly excited discussion; though it has not been always remembered that the inquiry as to the indigenous character of certain varieties of the tobacco plant in the old world, and even as to the use of such a narcotic, involve questions quite distinct from that of the origin of the very peculiar mode of partaking of the exhilerating or intoxicating effects of various narcotics by inhaling their burning fumes through a pipe.

The green tobacco, *nicotiana rustica*, cultivated in Thibet, western China, northern India, and Syria, is a different species from the American plant; and while it is affirmed by some to have been

brought from America, and even the precise date of 1570, is assigned for its importation into Britain, high authorities in Botany are still found to maintain the indigenous character of the *nicotiana rustica*, in some parts of the old world, as in northern India, where it is stated to grow wild. DuWalde, (1793.) speaks of tobacco as one of the natural productions of Formosa, whence it was largely imported by the Chinese; and Savary, Olearius, Chardin, and other writers, are all quoted* to show that the *nicotiana Persica*, which furnishes the famous shiraz tobacco, is not only indigenous to Persia, (an opinion favoured by high authorities in botany,) but that it was used for smoking from very early times. That all the varieties of the *Nicotiana* are not confined to the new world is unquestionable. Of some fifty-eight admitted species, the great majority are indeed American, but a few belong to the newer world of Australia, besides those believed to be indigenous to Asia. It is not surprising therefore, that after all the attention which this subject has latterly, on various accounts, attracted, writers should be found to maintain the opinion that the use of tobacco as a narcotic was known and practised by the Asiatics, prior to the discovery of America. The oriental use of tobacco may indeed be carried back to an era old enough to satisfy the keenest stickler for the antiquity of the practice, if he is not too nice as to his authorities. Dr. Yates in his *Travels in Egypt*, describes a painting which he saw on one of the tombs at Thebes, containing the representation of a smoking party. But this is modern compared with a record said to exist in the works of the early fathers, and, at any rate, preserved as an old tradition of the Greek Church, which ascribes the inebriation of the patriarch Noah to the temptation of the Devil by means of tobacco; so that King James was not, after all, without authority for the black stygian parentage he assigns to its fumes! Professor Johnston—who marshalls various authorities on the Asiatic use of tobacco for smoking, prior to the discovery of America, without venturing on any very definite opinion of his own,—quotes Pallas as arguing in favour of the antiquity of the practice from its extensive prevalence in Asia, and especially in China. "Amongst the Chinese," says this writer, "and among the Mongol tribes who had the most intercourse with them, the custom of smoking is so general, so frequent, and has become so indispensable a luxury; the tobacco-purse affixed to their belt so necessary an article of dress; the form of the pipes, from which the Dutch seem to have taken the model of theirs, so original;

* A. C. M. Exeter. Notes and Queries. Vol. II. p. 154.

and lastly, the preparation of the yellow leaves, which are merely rubbed to pieces, and then put into the pipe, so peculiar, that they could not possibly derive all this from America by way of Europe, especially as India, where the practice is not so general, intervenes between Persia and China." But the opinions of Dr. Meyen, formerly Professor of Botany in the University of Berlin, are worthy of still greater weight, set forth as they are, alike on Archælogical and Botanical grounds. In his "*Grundriss der Pflanzengeographie*," or "Outlines of the Geography of Plants," recently translated for the Ray Society, he observes: "It has long been the opinion, that the use of tobacco, as well as its culture, was peculiar to the people of America, but this is now proved to be incorrect by our present more exact acquaintance with China and India The consumption of tobacco in the Chinese empire is of immense extent, and the practice seems to be of great antiquity, for on very old sculptures I have observed the very same tobacco pipes which are still used. Besides we now know the plant which furnishes the Chinese tobacco, it is even said to grow wild in the East Indies. It is certain that this tobacco plant of eastern Asia is quite different from the American species. The genus Nicotiana, generally speaking, belongs to the warmer zones, yet a few species of it have a very extensive area, and a great power of resisting the influence of climate, for they can be grown under the equator, and in the temperate zone, even far above 55° north latitude, where the mean summer heat is equal to 15.87° Cels. The southern polar limit for the culture of tobacco is not exactly known, but it seems to extend to the 40th degree of latitude, for in south America tobacco is cultivated at Conception, and in New Zealand enough is grown for the consumption there."*

To India, then, Dr. Meyen inclines. with others, to refer the native habitat of an Asiatic tobacco, which he thus affirms to have been in use by the Chinese as a narcotic, and consumed by inhaling its smoke through a pipe, altogether independent of the introduction of this luxury to Europe by the discoverers of America in the fifteenth century. While the Turk still chews the opium in which he so freely indulges, the Chinese, and also the Malays smoke it, most frequently using as a pipe a bamboo, which serves also for a walking stick, and requires a very slight operation to convert it into an opium pipe. The Chinese opium smoker secures the utmost effects of that powerful narcotic by swallowing the smoke; and notwithstanding this mode of using the narcotic derived from the poppy is

* Meyen's Outlines of the Geography of Plants. Ray Society. Page 361.

acknowledged to be of comparatively recent introduction, when we call to remembrance that that strange people preceeded Europe in wood engraving, printing, the compass, and others of the most important of modern discoveries, there would be no just cause of surprise should it be proved that to them also we must ascribe such merit as pertains to the initiative in the uses to which tobacco is applied. Such evidence, however, must not be too hastily accepted; for a profoundly scientific botanist, though an altogether trustworthy authority in relation to the habitat of the plant, may be very little qualified to pronounce an opinion on the value of such Chinese monumental evidence as Dr. Meyen loosely refers to under the designation of "very old sculptures."

The Koran has been appealed to, and its modern versions even furnish the American name. A traditional prophecy of Mahomet is also quoted by Sale, which while it contradicts the assumed existence of tobacco in his time, foretells that: "in the latter days there shall be men bearing the name of moslem, but not really such, and they shall smoke a certain weed which shall be called tobacco!"* If the prophecy did not bear on the face of it such unmistakeable evidence of being the invention of some moslem ascetic of later times, it would furnish no bad proof of Mahomet's right to the title of "the false prophet," for Sale quotes in the same preliminary discourse to his edition of the Koran, the Persian proverb "coffee without tobacco is meat without salt." An appeal to the graphic pictures of eastern social habits in the "Arabian Nights' Entertainments," furnishes strong evidence against the ancient knowledge of a custom now so universal; and in so far as such negative evidence may be esteemed of any value, the pages of our own Shakespeare seem equally conclusive, though, as will be seen, the practice had not only been introduced into England, but was becoming familiarily known before his death.

The "drinking tobacco," as smoking was at first termed, from the mode of partaking of its fumes then practiced, finds apt illustration in the language of our great dramatist. The poet, in "Timon," speaks of the sycophantish followers of the noble Athenian "through him drinking free air;" in the "Tempest" Ariel, eager in her master's service, exclaims: "I drink the air before me," and in "Antony and Cleopatra," the Egyptian Queen thus wrathfully pictures the indignities of a Roman triumph :—

* Sale's Koran 8vo. Lond. 1812. p. 164

"Mechanic slaves
With greasy aprons, rules, and hammers shall
Uplift us to the view; in their thick breaths,
Rank of gross diet, shall we be enclouded,
And forced to *drink their vapour*."

The references to drinking usages, moreover, are scattered plentifully through all his dramas, and intensified by the most homely and familiar illustrations, but without a single reference indicative of smoking usages; though various passages occur strikingly suggestive of such allusions, had the practice been as familiar as it became in those of younger contemporaries who survived him. In "Much Ado About Nothing," Borachio tells Don John: "being entertained for a perfumer, as I was smoking a musty room, comes in the Prince and Claudio hand in hand, in sad conference." (Act I. Scene III.) Again in "Romeo and Juliet," Romeo thus speaks of brawling love:—

"O anything, of nothing first created!
O heavy lightness! Serious vanity!
Mis-shapen chaos of well seeming forms!
Feather of lead, *bright smoke, cold fire*, sick health!"

And again in the same scene he exclaims:—

'Love is a smoke made with the fume of sighs."

If, as Malone infers from a satire of Sir John Davis, and other early notices, tobacco was smoked by the wits and gallants on the English stage, before the close of the sixteenth century, it is difficult to evade the conclusion that such similes may have derived their force from the tobacco fumes which rose visibly in sight of the audience. These allusions and similes, however, have perhaps more resemblance in verbal form, than in embodied fancy, to the ideas now suggested; and may be deemed, after all, sufficiently independent of the smoker's "cloud" to involve no necessary association with it, even had such been familiar to the poet; but it seems to me scarcely possible that Shakespeare could have retained unmodified the language of Lady Macbeth, in the conclusion of the first act of "Macbeth,"—one of the productions of his later years,—had the fumes of tobacco been so associated with wine and wassail, as they were within a very few years after the date of that wonderful drama. Encouraging her husband to "screw his courage to the sticking place," she says:—

"His two chamberlains
Will I with wine and wassail so convince,
That memory, the warder of the brain,
Shall be a fume, and the receipt of reason
A limbeck only."

It may be, indeed, that the recently acquired knowledge of tobacco and its *fumes*, in Europe, sufficed to prevent the poet introducing such an anachronism amid scenes of ancient Scottish story. Nevertheless, a hypercritical adherence to archæological proprieties never interferes with the graphic touches which give life to every scene of the Shakespearean drama; and that the mere anachronism would not of itself have deterred Shakespeare from an allusion to tobacco, if its unfamiliar novelty did not render it unsuitable for his purpose, may be inferred from liberties of a like kind which have proved fertile texts to many a verbal critic. The soldier's simile in the same tragedy, (Act I., Scene II.,) where he compares the royal captains, Macbeth and Banquo, to "*cannons* overcharged with double cracks;" or Sweno of Norway, disbursing his ten thousand *dollars* at Saint Colmes Inch; (Act I., Scene III.,) or Menenius, in "Coriolanus," (Act V., Scene I.,) with his:—

> "Pair of tribunes that have rack'd for Rome
> To make *coals* cheap;"

or a hundred similar instances, familiar to the readers of our great dramatist, would all seem equally inadmissible were they not already there. It seems to me, however, that the association of tobacco "fumes" with "wine and wassail," a very few years later than the production of "Macbeth," would have prevented the use of the former term, in such an association in its less popular sense, as is done in that drama. The allusion there is to the rising of *fumes* of vapour, in distillation; but Bacon, who, in his thirty-third essay: "Of Plantations," speaks of the tobacco of Virginia as one of the "commodities which the soil where the plantation is, doth naturally yield," elsewhere recommends "that it were good to try *the taking of fumes by pipes, as they do in tobacco*, of other things to dry and comfort." Here therefore, we perceive the adoption of Shakespear's term "*fumes*," for the smoke of tobacco within a very few years after the production of "Macbeth," a work assigned by nearly all his best editors to the reign of James I.

It is curious indeed to note how nearly we can approximate to a precise date for the literary recognition of the "Indian weed," which has been such a favourite of the student in later times. Warner, who wrote his once popular "Albion's England," in 1586, added to it three additional books in 1606, in the first of which (Book XIV. chap. 91.), a critical imp inveighs against the decline of the manners of the good old times; and among other symptoms of decay, misses the smoke of the old manor-chimney, which once gave evidence of

the hospitable hearth within But, in lieu of this he notes a more perplexing smoke which "proceeds from nostrils and from throats of ladies, lords, and silly grooms," and exclaims astonished: —

"Great Belzabub! can all spit fire as well as thine?"

But his fellow Incubus allays his fears by telling him that this novelty:—

"Was an Indian weed,
That fumed away more wealth than would a many thousands feed."

Tobacco. therefore, was not only in use, but already indulged in to an extravagant excess, in Shakespeare's later years. Though unnamed in his works, it repeatedly occurs in those of Decker, Middleton, and others of the early minor dramatists; and still more familiarily in those of Ben Jonson, Beaumont and Fletcher, and others of later date. In Middleton's "Roaring Girl," produced in 1611, five years before the death of Shakespeaer, and peculiarly valuable from the lively. though sufficiently coarse picture it furnishes of London manners in his day, we learn that "a pipe of smoak" was to be purchased for sixpence. In Ben Jonson's "Alchemist," of the same date, "Drugger, the tobacco man," plays a part; and a similar character figures among the *dramatis personæ* of Beaumont and Fletcher's "Scornful Lady." Moreover, the earliest of these notices not only refers to the costliness of the luxurious weed, with a pipe of which. Drugger bribes the Alchemist; but the allusions are no less distinct to the adulterations practised even at so early a date, and which were no doubt hinted at by Jonson in the name of his tobacconist. "Doctor" exclaims Face, the servitor, to Subtle the Alchemist, when introducing Abel Drugger to his favourable notice, (Act. I., Scene I.):—

"Doctor, do you hear!
This is my friend Abel, an honest fellow;
He lets me have good tobacco, and he does not
Sophisticate it with sack-lees or oil,
Nor washes it in muscadel and grains,
Nor buries it in gravel under ground,
Wrapp'd up in greasy leather, or piss'd clouts,
But keeps it in fine lily pots, that open'd
Smell like conserves of roses, or French beans."

It is obvious here that, even thus early, Ben Jonson's allusions to the favourite "weed" are not to an unfamiliar novelty; though both with him, and in the later works of Beaumont and Fletcher, it is referred to invariably as a costly luxury. "Tis' good tobacco, this!" exclaims Subtle, "what is't an ounce?" and Savil, the steward, in

"The Scornful Lady" speaks ironically of "wealthy tobacco-merchants, that set up with one ounce, and break for three!" It shares indeed, with gambling, drinking, and other vices, in helping on the young spendthrifts of the drama to speedy ruin. In "Bartholomew Fair," (Act II., Scene VI,) the puritan Justice, Overdo, warns against "lusting after that tawny weed tobacco, whose complexion is like the Indian's that vents it!" and after berating it in terms scarcely quotable, he reckons the novice's outlay at "thirty pounds a week in bottle-ale, forty in tobacco!" So, too, in Beaumont and Fletcher's "Wit without Money," Valentine "a gallant that will not be persuaded to keep his estate," picturing to his faithless rivals in his love suit, the beggary that awaits them, sums up a list of the slights of fortune with: "English tobacco, with half-pipes, nor in half a year once burnt." More quaint is the allusion with which Robin Goodfellow, in "the Shepherd's Dream," (1612) fixes the introduction of the novel luxury, where reluctantly admitting the benefits of the Reformation, he bewails the exit of popery and the introduction of tobacco as concurrent events!

From this date the allusions to the use and abuse of the Indian weed abound, and leave no room to question the wide diffusion of the practice of smoking in the seventeenth century. Burton, in his "Anatomy of Melancholy," (1621), prescribes tobacco as "a sovereign remedy to all diseases, but one commonly abused by most men;" while in Zacharie Boyd's "Last Battell of the Soule in Death," printed at Edinburgh in 1629, the quaint old divine speaks of the backslider as one with whom "the wyne pint and tobacca pype with sneesing pouder, provoking sneuele, were his heartes delight!"

The term employed by Zacharie Boyd for snuff, is still in the abreviated form of "*sneeshin*," the popular Scottish name for this preparation of tobacco. There are not wanting, however, abundant proofs of the ancient use of aromatic powders as snuff, long before the introduction of tobacco to Europe. One familiar passage from Shakespeare will occur to all; where Hotspur describing the fopling lord "perfumed like a milliner," adds:—

> "And 'twixt his finger and his thumb he held
> A pouncet-box, which ever and anon
> He gave his nose, and took't away again;
> Who, therewith angry, when it next came there
> Took it in snuff."

The illustration which this passage affords of the ancient use of pungent and aromatic powders in one manner in which tobacco has been so extensively employed since its introduction into Europe,

adds greatly to the force of the argument against any older employment of narcotics in the way of inhaling their fumes, based on the absence of earlier notices of so remarkable a custom. The use indeed of various narcotics, such as opium, bang: the leaf of the hemp plant, and the betel-nut, the fruit of the Areca palm, by the south-eastern Asiatics appears to be traceable to a remote antiquity. Northern Europe has, in like manner, had its ledum and hop, and in Siberia, its *amanita muscaria*, or narcotic fungus. But the evidence fails us which should prove that in the case of the pipe, as in that of the pouncet-box, the tobacco only came as a substitute for older aromatics, or narcotics similarily employed. Nor when the evidence is looked into more carefully, are such direct proofs wanting, as suggest a comparatively recent origin, in so far as both Europe and Asia are concerned, to the peculiar mode of enjoying such narcotics by inhaling their fumes through a pipe attached to the bowl in which they are subjected to a slow process of combustion.

When engaged, some years since, in the preparation of a work on Scottish Archæology, my attention was directed, among various minor antiquities of the British Islands, to a curious class of relics popularly known in Scotland by the name of *Celtic* or *Elfin pipes*, in the north of England as *Fairy pipes*, and in Ireland where they are more abundant, as *Danes' pipes*. These are formed of white clay, with some resemblance to the form of the modern clay pipe, but variously ornamented, and invariably of a very small size compared with any tobacco-pipe in modern use. Similar relics have since been observed in England, found under circumstances calculated, like those attending the discovery of some of the Scottish examples to suggest an antiquity for them long anterior to the introduction of America's favourite narcotic, with what King James, on finding its taxability, learned to designate its "precious stink!' The most remarkable of such discoveries are those in which pipes of this primitive form have been found on Roman sites along side of genuine Roman remains. Such was the case, on the exposure, in 1852, of part of the ancient Roman wall of London, at the Tower postern; and, along with masonry and tiles, of undoubted Roman workmanship, a mutilated sepulchral inscription was found possessed of peculiar interest from supplying the only example, so far as I am aware, in Britain, of a Christian date of the second century:—

PO ANNO + C $\overset{\text{I}}{\text{L}}$XX*

In the summer of 1853, only a few months after this London dis-

* M.S. Letter J. W. Archer, Esq., London, April, 1853.

covery of "Fairy Pipes" along with Anglo-Roman remains of the second century, similar discoveries were made on the site of the Roman Town of Bremenium, and at one of the Forts on the wall of Hadrian, in Northumberland. The learned author of "The Roman Wall," thus refers to the discovery in the second edition of that work.* "Shall we enumerate smoking pipes, such as those shewn in the cut, [which precisely correspond to many similar examples of the smallest size of the so called *Fairy* or *Danes' Pipes*,] among the articles belonging to the Roman period? Some of them indeed, have a medieval aspect; but the fact of their being frequently found in Roman stations, along with the pottery and other remains, undoubtedly Roman, ought not to be overlooked." After some further remarks in detail, Dr. Bruce proceeds to quote the following passage from the "Prehistoric Annals of Scotland:"—

"Another class of relics found in considerable numbers in North Berwick, as well as in various other districts, are small tobacco-pipes, popularly known in Scotland by the names of *Celtic* or *Elfin pipes*, and in Ireland, where they are even more abundant, as *Danes' pipes*. To what period these curious relics belong I am at a loss to determine. The popular names attached to them, manifestly point to an era long prior to that of Sir Walter Raleigh and the maiden queen, or of the royal author of 'A Counterblast to Tobacco,' and the objects along with which they have been discovered, would also seem occasionally to lead to similar conclusions, in which case we shall be forced to assume that the American weed was only introduced as a superior substitute for older narcotics. Hemp may, in all probability, have formed one of these; it is still largely used in the east for this purpose."

When preparing the notices of miscellaneous minor Scottish antiquities, from which the above passage is abstracted, my attention had been directed, for the first time, to these relics of the old smokers' nicotian indulgences. The discovery of miniature pipes, under peculiar circumstances, had been noted in the Statistical Accounts and elsewhere, from time to time; but so far as I am aware, they had not been subjected to special notice or investigation by any previous Scottish antiquary; and finding evidence, then quoted†—of the discovery of the miniature *Elfin Pipe*, in "British encampments;" in the vicinity of a primitive monolithic monument, with flint arrow heads, stone celts, &c.: in an ancient cemetery, alongside of medieval pottery, at North Berwick; and at considerable depths in various localities; as for example, six feet in a moss between Scalloway and

* The Roman Wall, an historical and topographical description of the Barrier of the Lower Isthmus, extending from the Tyne to the Solway; by the Rev. J. C. Bruce, M. A. Second Edition, 1853, p. 441.

† Archæology and Prehistoric Annals of Scotland, 1851, p. 680.

Lerwick, in the Orkneys; I remarked in reference to such notices that some of them were certainly suggestive of the little Elfin pipes belonging to a remote era. When, however, my esteemed friend Dr. Bruce, quoted me in seeming confirmation of, at least the possibility that the old Roman Legionary of Hadrian or Severus occasionally solaced himself with a pipe, as he kept watch and ward on the ancient barrier which in the first centuries of our era marked the outer verge of the Roman world, he took from the page just as much as sufficed to give a delicate flavor of possibility to the fancy, so pleasant to the mind of a genuine devotee of the luxurious weed, that the tobacco-pipe is a classic institution!

I doubt not but the learned Roman Antiquary of Pons Ælia, in his zeal to provide the Tungrian Legionaries of old Borcovicus, or the Spanish Varduli of Bremenium, with the consolations of a pipe, to beguile their dreary outlook from that bleak Northumbrian outpost of Imperial civilzation, most honestly and unwittingly overlooked whatever failed to square with the manifest fitness of so pleasant a conceit; nor did it ever occur to me to think of putting the old Tungrians' pipe out, by continuing the quotation, until now when, in the tardy access to British periodicals, I find myself quoted as an authority for the antiquity of the tobacco-pipe,—not only by those who, favouring such an opinion, are willing to count even the most lukewarm adherent on their side, but by others who treat me as Oliver Proudfoot, the bonnet maker, did his wooden soldan, which he set up merely for the pleasure of knocking it down; or as the gallant Bailie and bonnet maker of Saint Johnstoune says: "Marry, and sometimes I will place you a bonnet (an old one most likely,) on my soldan's head, and cleave it with such a downright blow, that in troth, the infidel has but little of his skull remaining to hit at!" Far be it from me to interfere with the practice of those who, like the valiant bonnet maker, wish to make themselves familiar with the use of their weapon on such easy terms, even though, perforce, made the wooden soldan on which it is applied; but I must confess to a decided objection to being held responsible for opinions quoted only for the purpose of refutation, when as it would seem, these are read through such a refracting medium as the Roman spectacles of an antiquary, who may be assumed without any disparagement to be a little *wall-eyed.*

Quotations at second hand are never very trustworthy, and it seems difficult to credit with more direct knowledge than such as may be derived from the partial quotation in the "Roman Wall," such

writers as one in the *Archæological Journal*,* who, after referring to Mr. Crofton Croker's signal refutation of "this absurd notion," couples me with Dr. Bruce as "inclined to assign such pipes to an age long prior to that of Elizabeth and Sir Walter Raleigh." It might be unreasonable to blame a contributor of editorial notes to the *Archæological Journal* for overlooking a paragraph in the *Proceedings of the Scottish Antiquaries*, of date a year earlier than his note,† which records that "Dr. Wilson communicated a notice of the discovery of various of the small tobacco-pipes popularly termed 'Celtic' or 'Elfin pipes,' in digging the foundation of a new school house at Bonnington, in the immediate vicinity of Edinburgh. Along with these were found a quantity of bodles or placks of James VI., which he exhibited with the pipes, and at the same time expressed his belief that they probably supplied a very trustworthy clue to the date of this somewhat curious class of minor antiquities." This more matured opinion of 1853 lay out of the way, and might not be noticed by the Archæological Journalist, as it would assuredly have been overlooked by the zealous Roman, quite as much as the following continuation of the original quotation so aptly abridged to the proportions of his classic tunic. But any writer who looked in its own pages, for the opinions set forth on this subject, in the "Prehistoric Annals of Scotland," would have found that the abbreviated quotations in the "Roman Wall" and elsewhere, only give one side of the statement, and that, after referring to an article in the Dublin Penny Magazine, the inquiry is thus summed up:—

"The conclusion arrived at by the writer in that magazine is, that these Danes' pipes are neither more nor less than tobacco pipes, the smallest of them pertaining to the earliest years of Queen Elizabeth's reign, when the rarity and value of tobacco rendered the most diminutive bowl sufficiently ample for the enjoyment of so costly a luxury. From this he traces them down to the reign of Charles II. by the increasing dimensions of the bowl. *It is not improbable that these conclusions may be correct, notwithstanding the apparent indications of a much earlier origin, which circumstances attendant on their occasional discovery have seemed to suggest.*

The following description of a curious Scottish memorial of the luxury would, however, seem at least to prove that we must trace the introduction of tobacco into this country to a date much nearer the discovery of the new world by Columbus than the era of Raleigh's colonization of Virginia. The grim old keep of Cawdor Castle, associated in defiance of chronology with King Duncan and Macbeth, is augmented like the majority of such Scottish fortalices, by additions of the sixteenth century. In one of the apartments of this latter erection, is a stone

* Archæological Journal, Vol. XI., p. 182.

† Proceedings S. A. Scot. Vol. I. p. 182.

chimney, richly carved with armorial bearings and the grotesque devices common on works of the period. Among these are a mermaid playing the harp, a monkey blowing a horn, a cat playing a fiddle, and *a fox smoking a tobacco pipe.* There can be no mistake as to the meaning of the last lively representation, and on the same stone is the date 1510, the year in which the wing of the castle is ascertained to have been built,"* and in which it may be added, Jamaica was settled by the Spaniards.

Having thus even at the very first,—while "at a loss to determine to what period the curious relics called Dane's or Elfin pipes belonged," and consequently avoiding a dogmatic assertion on a subject "left for further investigation,"—furnished a tolerably significant indication of my inclination to assign to such nicotian relics a post-Columbian introduction to Britain; and having, moreover, at a later period given unequivocal expression of a confirmed opinion of their modern origin: I was somewhat surprised to find myself, not very long since, figuring alongside of a singularly creditable array of chivalrous archæologists, all knights of the ancient tobacco pipe, and ready to shiver a lance with any puny modern heretic who ventured to question that Julius Cæsar smoked his merchaum at the passage of the Rhine, or that Herodotus partook of a Scythian peace-pipe when gathering the materials for the birth of History! Here is the array of learned authorities, clipped out of a recent English periodical, produced as it will be seen, to answer in the affirmative, that *the ancients did smoke:* Scythian and Roman, Celt, Frank, and Norman!

Did the Ancients Smoke?—The question as to whether smoking was known to the ancients has just been started in Germany by the publication of a drawing contained in the *Recueil des Antiquités Suisses* of Baron de Bonstetten, which represents two objects in clay, which the author expressly declares to be smoking pipes. The authors of the "History of the Canton of the Grisons" had already spoken of these objects, but classified them among the instruments made use of by the soothsayers. The Abbé Cochet, in his work on Subterranean Normandy, mentions having found similar articles either whole or in fragments, in the Roman necropolis near Dieppe, which he at first considered as belonging to the seventeenth century, or perhaps to the time of Henri III. and Henri IV, The Abbé, however, afterwards changed his opinion on reading the work of Dr. Collingwood Bruce, entitled "The Roman Wall," in which the author asks the question whether the pipes discovered at. Pierce Bridge, in Northumberland, and in London, at places where Roman stations were known to have existed, belonged to the Romans? Dr. Wilson, in his Archæology of Scotland, states that tobacco was only introduced as a superior kind of narcotic, and that hemp was already known to the ancients as a sedative. The pipes found in Scotland by Dr. Wilson might have served for using this latter substance. M. Wœchter, in his "Celtic Monuments of Hanover," says that clay pipes from 6 to 8 inches in length had been found in tombs at

* Archæology and Prehistoric Annals of Scotland, p. 681. The Cawdor sculpture and date are described on the authority of Mr. Caruthers, a very trustworthy observer.

Osnabruck, which proved that the ancients smoked. M. Keferstein, in his "Celtic Antiquities," boldly declares that the Celts smoked. Klemm, in his "History of Christian Europe," states that the smoking of intoxicating plants was known to the Scythians and Africans long before the introduction of tobacco into Europe. Herodotus, in speaking of the Scythians, does not go quite so far, but mentions that the people spread hemp seed on red-hot stones and inhaled the vapour sent forth. It is therefore thought by Baron de Bonstetten that the pipes of which he gives the drawing were used before the introduction of tobacco into Europe.*

This is by no means the first time that classic authorities have been quoted in proof of the antiquity of smoking. In the *Anthologia Hibernica*,† for example, a learned treatise aims to prove, on the authority of Herdotus (lib. I. Sec. 36,) Strabo, (lib. vii. 296), Pomponius Mela, (2.) and Solinus (c. 15,) that the northern nations of Europe were acquainted with tobacco, or an herb of similar properties, long before the discovery of America, and that they smoked it through small tubes. Pliny has also been produced to show that Coltsfoot (*tussilago farfara*, a mucilagenous and bitter herbaceous plant, the leaves of which were once in great favor for their supposed medicinal qualities,) furnished a substitute for the American plant which superseded this and other fancied supplies of the ancients' pipes. Speaking of that plant as a remedy for a cough, (Nat. Hist. xxvi. 16.) Pliny says:—"Hujus aridæ cum radice fumus per arundinem, haustus et devoratus, veterem sanare dicitur tussim; sed in singulos haustus passum gustandum est." This, however, is nothing more than a proof of the antiquity of a process of applying the fumes or steam of certain plants, for medicinal purposes, which is recommended in a treatise on "the Vertues of Colefoot" in the *Historie of Plantes*, by Rembert Dodoens, translated and published in England in 1578. "The parfume of the dryed leaves" says he, "layde upon quicke coles, taken into the mouth through the pipe of a funnell, or tunnell, helpeth suche as are troubled with the shortness of winde, and fetche their breath thicke or often." So far, how-

* Quoted in the North British *Daily Mail*, July 24th, 1856, but without naming the original source. It was copied into the *Illustrated Times*, of July 26th, and by other periodicals, but there also without reference to the original authority. In this case I cannot doubt that the writer who thus loosely quotes, or misquotes, the "Archæology of Scotland" does it at second hand, from Dr. Bruce.

† Vol. I., p. 352, quoted in *Notes and Queries*, X. 48. The subject has been handled in all lights, and each view of the questions it involves has found its defenders in this useful periodical,—doubly useful to those who are cut off from the great public libraries. In N. and Q., vol. II., p. 154, much curious information is concisely given relative to the assumed use of tobacco, anciently, and in the East. Ibid p. 150. Its Eastern antiquity finds a contradiction on the authority of Lane, and still more of Dr. Meyer of Konigsberg, who discovered in the works of an old Hindostanee physician, a passage in which tobacco is distinctly stated to have been introduced into India, by the Frank nations, in the year 1609.

ever, is this ancient process from indicating a mode of inhaling herbs, in any sense equivalent to the American luxury by which it may be supposed to have been superseded, that it is by no means banished, even now, from the practise of ancient female herbalists and domestic mediciners, whom I have known recommend the inhalation of the fumes or steam of various plants, not by means of a tobacco pipe, but through the spout of a teapot!

There is no question, however, that many plants have been employed as substitutes for tobacco, since the introduction of the practice of smoking. The slight astringency and diuretic qualities of *polytrichum* and other *Bryaceæ*, led to their use formerly in medicines, and the practice was once common, as I have been assured, in Annandale, and other border districts of Scotland, and is not even now wholly obsolete, of smoking the dried *sphagnum latifolium*, or the *obtusifolium* and others of the mosses which abound in the marshy bogs. So also the *millefolium* or yarrow, one of the various species of the genus *Achillea*, and several of the herbs which from their shape and the velvet surface of the leaves, are popularly known by the name of *mouse ear*, have long supplied to the English rustic an economic substitute for tobacco; just as the sloe, hawthorn, sage, and other leaves have furnished a native apology for the tea plant. But the "time immemorial" to which such practice extends probably falls far short of well ascertained dates when tobacco and the tobacco pipe were both recognized as gifts of the new world to the old. But it is curious to note, that one of the most anciently accredited substitutes for tobacco: the coltsfoot, appears to have been employed to adulterate it almost as soon as it came into use in England. Dame Ursla, in Ben Jonson's "Bartholomew Fair," (1614,) thus addresses her dull tapster:—"I can but hold life and soul together with this, and a whiff of tobacco at most, where's my pipe now? not filled, thou errant incubee! · · · Look too't sirrah, you were best; threepence a pipe full, I will ha' made, of all my whole half-pound of tobacco, and a quarter of a-pound of *coltsfoot* mix't with it too, to itch [eke] it out. I that have dealt so long in the fire will not be to seek in smoke now."

The libraries of Canada furnish very slender means for dallying with the Bibliography of the nicotian art. But some of the references made above may be thought to bear on the subject, and the very terms in which the royal author of the "Counterblaste" assails it as a novelty of such recent origin "as this present age can very well remember both the first author and forms of its introduction," seem

sufficiently clear evidence that smoking was unknown to Europe before the discovery of this continent. Spain doubtless first enjoyed the novel luxury; probably—at the latest,—not long after the commencement of the sixteenth century. The year 1560 is assigned for its introduction into France, and most commonly that of 1586,—in which Admiral Drake's fleet returned from the attack on the west Indian Islands—for its reaching England. But though in all probability only beginning at these dates to attract special attention, the custom of smoking tobacco can scarcely be supposed to have remained unknown to the Spaniards before the close of the fifteenth century, or to have failed to have come under the notice both of French and Englishmen at an early period thereafter. When at length fairly introduced into England, it met with a ready welcome. So early as 1615, we find the popular poet, Joshua Sylvester following in the wake of the royal counterblast, with his:—"tobacco battered, and the pipes shattered about their ears that idly idolize so base and barbarous a weed, or at leastwise overlove so loathsome a vanity, by a volley of holy shot thundered from Mount Helicon."—tolerable proof of the growing favour for the "weed." The plant itself was speedily brought over and cultivated in various districts, till prohibited by an act of Parliament; and Pepys, in his Diary,—referring to Winchcombe, in Gloucestershire, where tobacco is affirmed to have been first raised in England,—under the date, September 19th, 1667, mentions the information communicated to him by his cozen, Kate Joyce: "now the life-guard, which we thought a little while since was sent down into the country about some insurrection, was sent to Winchcombe, to spoil the tobacco there, which it seems the people there do plant contrary to law, and have always done, and still been under force and danger of having it spoiled, as it hath been oftentimes, and yet they will continue to plant it."*

Another entry of the same indefatigable diarist, furnishes evidence not only of the early faith in the anti-contagious virtues of tobacco, but also of the no less early mode of using it in England according to a fashion which is now more frequently regarded as a special prerogative of young America. On the 7th of June, 1665, Pepys notes that the first sight of the plague-cross, with its accompanying solemn formula of prayer, moved him, not to a devotional ejaculation, as might perhaps seem most fitting, but only to chew tobacco! "The hottest day," he writes, "that ever I felt in my life. This day, much against my will, I did in Drury Lane, see two or three houses marked

* Pepys' Diary, 4th Edition. Vol. III., p. 252.

with a red cross upon the doors, and 'Lord have mercy upon us!' writ there; which was a sad sight to me, being the first of the kind that, to my remembrance I ever saw. It put me in an ill conception of myself and my smell, so that I was forced to buy some roll-tobacco to smell to and chaw, which took away the apprehension."*

The costly nature of the luxury has been assumed as furnishing ample explanation alike of the minute size of the original tobacco pipe,—which in all probability secured for it in later times its designation of "Elfin" or "Fairy Pipe."—and of the early substitution of native pungent and fragrant herbs for the high priced foreign weed. The circumstances, however, which render the rarer English literature of the sixteenth and seventeenth centuries inaccessible here, have furnished resources of another kind which may perhaps be thought to account for this on other, and no less probable grounds. During a visit to part of the Minnesota Territory, at the head of Lake Superior, in 1855, it was my good fortune to fall in with a party of the Saultaux Indians,—as the Chippeways of the far west are most frequently designated,—and to see them engage in their native dances, in foot-races, and other sports, and among the rest: in the luxury of the pipe. It is scarcely necessary to remark that the Indian carries his pipe-stem in his hand, along with his bow, tomahawk, or other weapon, while the pipe itself is kept in the tobacco pouch, generally formed of the skin of some small animal, dressed with the fur, and hung at his belt. But what struck me as most noticeable was that the Indians in smoking, did not exhale the smoke from the mouth, but from the nostrils; and this, Mr. Paul Kane assures me is the universal custom of the Indians of the north west, among whom he has travelled from the Red River settlement to the shores of the Pacific. By this means the narcotic effects of the tobacco are greatly increased, in so much so that a single pipe of strong tobacco smoked by an Indian in this manner, will frequently produce complete giddiness and intoxication. The Indians accordingly make use of various herbs to mix with and dilute the tobacco, such as the leaf of the cranberry, and the inner bark of the red willow, to both of which the Indian word *kinikinik* is generally applied, and the leaves of the winterberry, which receives the name of *pahgezegun*.† The cranberry

* Pepy's Diary, 4th Edition. Vol. II., p. 242.

† I am informed by the Rev. Dr. O'Meara, the translator of the Bible in the Chippeway tongue, that the literal significance of *kinikinik* is "he mixes." *kinikangun* is "a mixture," and the words are applied by the Indians not to the diluent alone, but to the tobacco and diluents when mixed and prepared for use. So also *pahgezegun* is "anything mixed," and may be rendered: something to mix with tobacco.

and winterberry leaves are prepared by passing them through the top of the flame, or more leisurely drying them over the fire, without allowing them to burn. Among the Creeks, the Chocktaws, and other Indians in the south, the leaves of the sumach, prepared in a similar manner, answer the like purpose. The leaf of the winterberry, or tea berry, (*coltheria procumbens*,) has a pleasant aroma, which may have had some influence on its selection. The Indians of the north west ascribe to it the further property of giving them wind, and enabling them to hold out longer in running; but the main object of all such additions appears to be to dilute the tobacco,and thereby admit of its prolonged enjoyment. Having both chewed and smoked the winterberry leaf prepared by the Indians, I am able to speak positively as to the absence of any narcotic qualities, and I presume that with it and all the other additions to the tobacco, the main object is to provide a diluent, so as to moderate the effects, and prolong the enjoyment of the luxury. The same mode is employed with ardent spirits. Mr. Kane remarks of the Chinook Indians: it is a matter of astonishment how very small a quantity of whisky suffices to intoxicate them, although they always dilute it largely in order to prolong the pleasure they derive from drinking.

The custom of increasing the action of the tobacco fumes on the nervous system, by expelling them through the nostrils, though now chiefly confined to the Indians of this continent, appears to have been universally practised when the smoking of tobacco was introduced into the old world. It has been perpetuated in Europe by those who had the earliest opportunities of acquiring the native custom. The Spaniard still expels the smoke through his nostrils, though using a light tobacco, and in such moderation as to render the influence of the narcotic sufficiently innocuous. The Greek sailors in the Levant very frequently retain the same practice, and with less moderation in its use. Melville also describes the Sandwich Islanders, among whom tobacco is of such recent introduction, as having adopted the Indian custom, whether from imitation or by a natural savage instinct towards excess; and evidence is not wanting to prove that such was the original practice of the English smoker. Paul Hentzner, in his "Journey into England." in 1598,* among other novelties describes witnessing at the playhouse, the practice, as then newly borrowed from the Indians of Virginia. "Here," he says, "and everywhere else, the English are

* Malone quotes from epigrams and satires of the same date,—eighteen years before the death of Shakespear,—to prove that playgoers, even at so early a date, were attended by pages, with pipes and tobacco, which they smoked on the stage, where the wits were then wont to sit. Vide *Notes and Queries*, vol. X., p. 49.

constantly smoking of tobacco, and in this manner: they have pipes on purpose made of clay, into the further end of which they put the herb, so dry that it may be rubbed into powder, and putting fire to it, they draw the smoke into their mouths, which they puff out again through their nostrils, like funnels, along with it plenty of phlegm, and defluxion of the head."

To this it is, that Justice Overdoo refers in Ben Jonson's "Bartholomew Fair," (Act II., Scene VI.) "Nay, the hole in the nose here, of some tobacco-takers, or the third nostril, if I may so call it, which makes that they can vent the tobacco out, like the ace of clubs, or rather the flower-de-lice, is caused from the tobacco, the mere tobacco!" and so also, in a passage already referred to, in Warner's "Albion's England," the "Indian weed fumes away from nostrils and from throats" of ladies, as well as lords and grooms.

The minute size of the most ancient of the British tobacco pipes which has led to their designation as those of the Elves or Fairies, may therefore be much more certainly ascribed to the mode of using the tobacco, which rendered the contents of the smallest of them a sufficient dose, than to any economic habits in those who indulged in the novel luxury. In this opinion I am further confirmed by observing the same miniature characteristics mark various specimens of antique native pipes of a peculiar class to which I have already referred as found in Canada, and which appear to be such as, in all probability were in use, and furnished the models of the English clay pipes of the sixteenth century. But if the date thus assigned for the earliest English clay pipes be the true one, it has an important bearing on a much wider question; and as a test of the value to be attached to popular traditions, may suggest the revision of more than one archæological theory based on the trustworthiness of such evidence. A contributor to "Notes and Queries,"* quotes some dogrel lines printed in the "Harleian Miscellany" in 1624, where speaking of the good old times of King Harry the Eighth, smoking is thus ludicrously described as a recent novelty:—

"Nor did that time know
To puff and to blow,
In a piece of white clay
As you do at this day,
With fier and coale
And a leafe in a hole!"

These lines are ascribed in the original to Skelton, who died in 1529, and by a course of reasoning which seems to run somewhat in

*Notes and Queries. Vol. VII., p. 230.

a circle, it is assumed that they cannot be his, *because* tobacco was not introduced into England "till 1565 or thereabouts." Brand in his "Popular Antiquities," ascribes its introduction to Drake in 1586; while the old keep at Cawdor, already referred to, with its sculptured reynard and his pipe, would carry it back to 1510, and by implication still nearer the fifteenth century. So peculiar a custom as smoking, would no doubt, at first be chiefly confined to such as had acquired a taste for it in the countries from whence it was borrowed, and until its more general diffusion had created a demand for tobacco, as well as for the pipe required for its use, the smoker who had not acquired an Indian pipe along with the "Indian weed," would have to depend on chance, or his own ingenuity, for the materials requisite for its enjoyment. Hence an old diarist writing about 1680, tells us of the tobacco smokers:—"They first had silver pipes, but the ordinary sort made use of a walnut shell and a straw. I have heard my grandfather say that one pipe was handed from man to man round the table. Within these thirty-five years 'twas scandalous for a divine to take tobacco. It was then sold for its weight in silver. I have heard some of our old yeomen neighbours say, that when they went to market they culled out their biggest shillings to lay in the scales against the tobacco; now the customs of it are the greatest his majestie hath." In the interval between the primitive walnut-shell pipe, or the single clay pipe for a whole company to partake of the costly luxury, and this later era of its abundant use, the supply of pipes had, no doubt, kept pace with that of the tobacco, and they had undergone such alterations in form as were requisite to adapt them to its later mode of use. Their material also had become so uniform, and so well recognised, that a clay pipe appears to have been regarded, in the seventeenth century as the sole implement applicable to the smoker's art. An old string of rhymed interogatories, printed in *Wit's Recreations*, a rare miscellany of 1640, thus quaintly sets forth this idea:—

"If all the world were sand,
Oh, then what should we lack'o;
If as they say there were no clay,
How should we take tobacco?"

Towards the latter end of the sixteenth, and in the early years of the seventeenth century, under any view of the case, small clay pipes, such as Teniers and Ostade put into the mouths of their Boors, must have been in common use throughout the British Islands. They have been dredged in numbers from the bed of the Thames, found in

abundance on various sites in England and Ireland, where the soldiers of the parliament and revolution encamped; and in Scotland in divers localities from the border, northward, even to the Orkneys. They have been repeatedly met with in old Churchyards, and turned up in places of public resort. Occasionally too, to the bewilderment of the antiquary, they are discovered in strange propinquity to primitive, Roman, and medieval relics,—but in a sufficient number of cases with such potters' stamps on them as suffice to assign these also to the sixteenth and seventeenth centuries. At a date so comparatively recent as that of the revolution of 1688, they must have been nearly as familiar throughout Britain and Ireland, as the larger clay pipe of the present day: and yet towards the end of the eighteenth century we find them described in Scottish statistical reports as "Elfin pipes;" and when at a later date, they attract a wider attention, it is found that, in total independence of each other, the peasantry of England, Scotland, and Ireland, have concurred in ascribing these modern antiques to the Danes, the Elves and the Fairies! I must confess that the full consideration of all the bearings of this disclosure of the sources of modern popular belief has greatly modified the faith I once attached to such forms of tradition as memorials of the past. The same people who, by means of Welsh *triads*, genealogical poems, like the *Duan Albannach* and *Eireannach*, and historical traditions, like the memory of the elder home of the Saxons in the *Gleeman's song*, could transmit, by oral tradition alone, the chronicles of many generations, now depend so entirely on the chroniclings of the printing press, that they cannot be trusted with the most familiar traditions of a single century. This no doubt only applies to very modern centuries; but the treacherousness of the historical memory of a rude savage people is sufficiently illustrated be the fact that we search in vain among the Indians of this continent for any tradition of the first intrusion of the white man.

A few general remarks on the varying characteristics of the pipes anciently constructed, or now in use among the Indian tribes of North America will not be out of place here, as a means of illustrating the customs and ideas associated at various times, and among different tribes, with the peculiar rites and usages of the pipe as the special characteristic of the new world. For some of the facts relating to the Indians of the north west, I am indebted to the Rev. Dr. O'Meara, missionary among the Chippeways; to Dr. George Beattie, formerly United States Indian Agent of the Winnebagos, —who have since been driven to desert their old hunting grounds in

Wisconsin for the far west, and from their rapidly diminishing numbers, cannot long survive as a distinct tribe,—and also, in special reference to those of the remote north west, and on the shores of the Pacific, to Mr. Paul Kane, along with the information derived from inspecting a fine collection of Indian relics secured by him during three years travel in the Hudson Bay Company's Territory, and among the neighbouring tribes within the territories of the United States. A comparison of the facts thus obtained with some of the conclusions arrived at by others from the examination of the older traces of the custom and usages of smoking, appear calculated to throw some additional light on the latter, and especially to modify the opinion derived from the investigation of examples of the ancient arts of the Mound Builders, and other aboriginal traces of this continent.

Insignificant, and even puerile, as the subject of the tobacco pipe appears, it assumes an importance in many respects only second to that of the osteological remains of the ancient races of this continent when viewed as part of the materials of its unwritten history. In Messrs. Squier and Davis' valuable "Contribution to Knowledge"* the tobacco pipes found in the ancient sepulchral mounds of the Mississippi Valley are specially noted as constituting not only a numerous, but a highly interesting class of remains, on the construction of which the artistic skill of their makers seems to have been lavished with a degree of care and ingenuity bestowed on no other works. "They are sculptured into singular devices: figures of the human head, and of various beasts, birds, and reptiles. These figures are all executed in miniature, but with great fidelity to nature." Thus, for example, the authors remark in reference to one pipe-head (Fig. 183, p. 268,) carved in the shape of a toad: the knotted, corrugated skin is well represented, and the sculpture is so very truthful that if placed in the grass before an unsuspecting observer, it would probably be mistaken for the natural object; and they further add: "those who deem expression in sculpture the grand essential, will find something to amuse as well as to admire, in the lugubrious expression of the mouths of these specimens of the toad." The same writers again remark, in describing the immense deposit of pipes found on the "altar" of one of the great mounds in the Scioto Valley, some of them calcined, and all more or less affected by the fires of the ancient ceremonial of cremation or sacrifice:—"The bowls of most of the pipes are carved in miniature figures of animals,

* Ancient Monuments of the Mississippi Valley, pages 228, 229.

birds, reptiles, &c. Not only are the features of the various objects represented faithfully, but their peculiarities and habits are in some degree exhibited. The otter is shewn in a characteristic attitude, holding a fish in his mouth; the heron also holds a fish; and the hawk grasps a small bird in its talons, which it tears with its beak. The panther, the bear, the wolf, the beaver, the otter, the squirrel, the racoon, the hawk, the heron, crow, swallow, buzzard, the paroquet, toucan, and other indigenous and southern birds; the turtle, the frog, toad, rattlesnake, etc., are recognised at first glance."* To this comprehensive list Mr. Squier makes further additions in a work of later date. Contrasting the truthfulness of the carvings from the mounds with the monstrosities or caricatures of nature usually produced by the savage sculptor, he remarks: "they display not only the general form and features of the objects sought to be represented, but to a surprising degree their characteristic expression and attitude. In some instances their very habits are indicated. Hardly a beast, bird, or reptile, indigenous to the country is omitted from the list;" and in addition to those named above, he specifies the elk, the opossum, the owl, vulture, raven, duck, and goose, and also the alligator.† Of no less interest are the numerous examples of sculptured human heads, some of them presenting striking traits of individual portraiture, and which are assumed, from the minute accuracy of many of the accompanying sculptures of animals, to furnish faithful representations of the predominant physical features of the ancient people by whom they were made.

Compared with the monuments of Central and Southern America, the sculplured façades of the temples and palaces of Mexico and Peru, the friezes adorned with hieroglyphics, the kalendars, and colossal statues of gods and heroes, of Yucatan: the art which found its highest object in the decoration of a pipe-bowl is apt to appear insignificant enough. Nevertheless, the simplicity, variety, and expression of these miniature works of art, their evidence of great imitative skill, as well as of delicacy of execution, all render them just objects of interest and careful study. But high as is the value which attaches to them as examples of the primitive æsthetic arts of this continent, they have a still higher significance in relation to ethnological inquiries. By the fidelity of their representations of so great a variety of objects derived from the animal kingdom, they furnish evidence of a knowledge, possessed by these ancient artists of the

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* Ancient Monuments of the Mississippi Valley. Page 152.

†Antiquities of the State of New York. Page 338.

Mississippi Valley, of the fauna peculiar not only to southern, but to tropical latitudes, suggestive either of arts derived from a foreign source, and of an intimate intercourse maintained with the central regions where the civilization of ancient America attained its highest devellopment, or else indicative of a migration from the south, and an intrusion into the northern area of the continent, of the race of the ancient graves of Central America, bringing with them into their new area the arts of the tropics, and models derived from the animals familiar to their fathers in the parent-land of the race.

That such a migration,— rather than a contemporaneous existence of the same race over the whole area thus indicated, and maintaining intimate intercommunication and commercial intercourse, is the more probable inference, is suggested on various grounds. If the Mound Builders had some of the arts and models, not only of Central America, but of Peru, they had also the native copper of Lake Superior, and mica believed to be traceable to the Alleghanies, while the gigantic tropical shells of the Gulf of Mexico have been found alike in these ancient mounds and in the graves along the shores of Lake Huron and Georgian Bay. The fact indeed that among the specimens of their most elaborate carving, some of the objects represent birds and quadrupeds belonging to latitudes so far to the south, naturally tends to suggest the idea of a central region where the arts were cultivated to an extent unknown in the Mississippi regions, and that those objects manufactured in the localities where such models are furnished by the native fauna, remain only as the evidences of ancient commercial relations maintained between these latitudes and the localities where now alone such are known to abound. But in opposition to this, full value must be given to the fact that neither the relics, nor the customs which they indicate, appear to pertain exclusively to southern latitudes, nor are such found to predominate among the singular evidences of ancient and more matured civilization either in Central or Southern America, while the varied nature of the materials employed in the arts of the Mound Builders, indicate a very wide range of relations; though it cannot be assumed that these were maintained in every case by direct intercourse.

The earlier students of American Archæology, like the older Celtic Antiquaries of Britain; gave full scope to a system of theorising which built up comprehensive ethnological schemes on the very smallest premises; but in the more judicious caution of later writers there is a tendency to run to the opposite extreme. Dr. Schoolcraft

certainly manifests a disposition to underrate the artistic skill unmistakably discernable in some of the works of the Mound Builders; while Mr. Haven solves the difficulty by referring such evidences of art to an undetermined foreign source. After describing the weapons, pottery, and personal ornaments obtained from the mounds, the latter writer adds, "and, with these were found sculptured figures of animals and the human head, in the form of pipes, wrought with great delicacy and spirit from some of the hardest stones. The last-named are relics that imply a very considerable degree of art, and if believed to be the work of the people with whose remains they are found, would tend greatly to increase the wonder that the art of sculpture among them was not manifested in other objects and places. The fact that nearly all the finer specimens of workmanship represent birds or land and marine animals belonging to a different latitude, while the pearls, the knives of obsidian, the marine shells, and the copper, equally testify to a distant, though not extra-continental origin, may however exclude these from being received as proofs of local industry and skill."* A reconsideration of the list already given of animals sculptured by the ancient pipe-makers of the mounds, as quoted from the narrative of Messrs. Squier and Davis, along with the later additions of the former, set forth in a form still less in accordance with such deductions, will, I conceive, satisfy the inquirer that it is quite an over statement of the case to say that nearly all represent animals belonging to a different latitude. The real interest, and difficulty of the question lies in the fact of discovering, along with so many spirited sculptures of animals pertaining to the locality, others represented with equal spirit and fidelity, though belonging to different latitudes. On this subject, familiarity with early British antiquities induces me to regard such an assignment of all the sculptures of the mounds to a foreign origin, on account of their models being in part derived from distant latitudes, as a needless assumption which only shifts without lessening the difficulty. On the sculptured standing stones of Scotland—belonging apparently to the closing era of paganism, and the first introduction of christianity there,—may be seen the elephant, the camel, the tiger or leopard, the ape, the serpent, and other representations or symbols, borrowed, not like the models of the Mound Builders, from a locality so near as readily to admit of the theory of direct commercial intercourse, but some of them from the remote extreme of Asia. The only difference between the imitations of the foreign

* Haven's Archæology of the United States. Page 122.

fauna of the Scottish and the ancient American monuments, is that the former occasionally betray, as might be expected, the conventional characteristics of a traditional type,* while the latter, if they furnish evidence of migration, prove it to have been recent, and to a locality not so distant as to preclude all renewal of intercourse with their ancestral birth-land.† Notwithstanding the great spirit displayed in many of the miniature sculptures of the Mound Builders, however, the difference in point of fidelity of imitation between them and the carvings of foreign subjects on the Scottish standing stones though unmistakeable, is not so great as the descriptions of American Archæologists would suggest; while both are alike accompanied by the representations of monstrosities or ideal creations of the fancy, which abundantly prove that the ancient sculptors could work without a model. Some of the human heads of the American sculptures for example, if regarded as portraits, must be supposed to be designed in the style of *Punch* !‡ and several of the animals figured in "The Ancient Monuments of the Mississippi Valley," e. g. the wild cat, Fig. 158; the "very spirited, though not minutely accurate head of the Elk," Fig. 161, and the supposed "cherry birds," Figs. 174, 175, of one of which it is remarked: "nothing can exceed the life-like expression of the original;" fall far short of the fidelity of imitation ascribed to them in the accompanying text.

It has been noted by more than one American Archæologist as a singular fact that no relics obviously designed as idols, or objects of worship, have been dug up in the mounds, or found in such circumstances as to connect them with the religious practices of the Mound Builders. But the very remarkable characteristics of their elaborately sculptured pipes, and the obviously important part they appear to have played in the services accompanying the rites of sacrifice or cremation, and the final construction of the gigantic earth-pyramids

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* It is worthy of note that the objects least truthfully represented among the sculptures of the Mound Builders, also, in some cases at least, appear to be those of animals foreign to the region, e. g. the Toucan (?) "Ancient Monuments of the Mississippi Valley;" Fig. 169, page 260; which might have been better described as a Raven; and Fig. 178, also a Toucan, but much more of a traditional than truthful portraiture.

† Vide Archæology and Prehistoric Annals of Scotland. Page 501, and Dr. Wise's Notes on Buddhist Opinions and Monuments. Transactions of R.S.E. Vol. XXI. Page 255.

‡ Vide Davis and Squier's Ancient Monuments, Fig. 145, described as the most beautiful of the series, and a head, the workmanship of which is unsurpassed by any specimen of ancient American Art, not excepting the best productions of Mexico and Peru,—fully bears out these remarks. But in contrast with it may be placed Figs. 143, 146 and 148; and as a still stronger illustration of how far the enthusiasm of the most careful observers may lead them compare Fig. 75, page 193, with the description which says of it: "the attitude is alike natural and spirited!"

which have given the name to the race that furnished the artists by whom they were wrought, all tend to suggest very different associations with the pipe of those ancient centuries from such as now pertain to its familiar descendant. It has accordingly been supposed that the elaborate employment of the imitative arts on the pipe-heads found deposited in the mounds, indicate their having played an important part in the religious solemnities of the ancient race, among whom the number of such relics proves that the practice of smoking was no less universal than among the modern Indians. The conjecture that this practice was more or less interwoven with the primitive civil and religious observances of America is thus illustrated by the authors already quoted,* from the more modern customs and ideas connected with it: " the use of tobacco was known to nearly all the American nations, and the pipe was their grand diplomatist. In making war and in concluding peace it performed an important part. Their deliberations, domestic as well as public, were conducted under its influences , and no treaty was ever made unsignalized by the passage of the calumet. The transfer of the pipe from the lips of one individual to those of another was the token of amity and friendship, a gage of honor with the chivalry of the forest which was seldom violated. In their religious ceremonies, it was also introduced with various degrees af solemnity. The custom extended to Mexico, where, however, it does not seem to have been invested with any of those singular conventionalities observed in the higher latitudes. It prevailed in South America and the Caribbean Islands."

To be continued.

ON THE OCCURRENCE OF THE GENUS CRYPTOCERAS IN SILURIAN ROCKS.

BY E. J. CHAPMAN,

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Read before the Canadian Institute, 18th April, 1857.

But one living genus of the chamber-shelled cephalopods being known, the classification of the numerous fossil types met with more particularly in the Palæozoic and Secondary rocks, is of necessity

* Ancient Monuments of the Mississippi Valley. Page 229.

based on characters derived immediately from the shell itself. For the purpose of classification, four characters, of more or less value, are especially available. These comprise:—(1) the character of the aperture; (2) the form of the septa; (3) the position and character of the siphuncle; and (4) the form and mode of growth of the shell.

The aperture may be: (*a*) open; (*b*) contracted. The septa: (*a*) simple; (*b*) angular or lobed. The position of the siphuncle: (*a*) central or sub-central; (*b*) internal or "ventral;" (*c*) external or "dorsal." The siphuncle itself: (*a*) simple; (*b*) complicated. The form of the shell: (*a*) straight or conical; (*b*) arched or "horned" in various ways; (*c*) discoidal, with or without contiguous volutions; and (*d*) spiral.

By means of these characters, all the trustworthy genera of the chambered cephalopods may be arranged, conveniently at least, if not naturally, in ten sections or families*: as shewn in the following tabular view:—

1. GOMPHOCERATIDÆ:—Aperture contracted. *Gomphoceras* (including Hall's *Orthoceras fusiforme;*) *Phragmoceras; Oncoceras; Lituites?*

2. HETEROSIPHONIDÆ:—Aperture unknown, perhaps contracted. Siphuncle more or less complicated, or otherwise marginal, with conical orthoceras-like shell. Septa simple or slightly wavy. (See remarks below.) *Endoceras; Cameroceras?; Gonioceras; Ormoceras; Ascoceras.*

3. NAUTILIDÆ: Aperture open. Septa simple, Siphuncle central or sub-central: *Orthoceras; Nautilus; Lituites; Hortolus; Aploceras* (including Hall's *Cyrtoceras Annulatum?*) *Nautiloceras; Trochoceras.*

4. TROCHOLITIDÆ:—Aperture open. Septa simple. Siphuncle internal or "ventral." *Trocholites.*

5. CYRTOCERATIDÆ:—Aperture open. Septa simple. Siphuncle external or "dorsal":—*Cyrtoceras; Gyroceras; Cryptoceras.*

6. CLYMENIDÆ:—Aperture open. Septa lobed. Siphuncle internal. *Clymenia; Sub-clymenia.*

* Many palæontologists will, no doubt, think an extended sub-division of this kind very unnecessary, and prefer to group these forms in two, or at the most, in three families; but in adopting this plan, the characters of the respective families become ill-defined, and the appreciation of transition groups much weakened; whilst, at the same time, a necessity is occasioned for the creation of sub-families or tribes. A classification which does not shew upon its face a greater distinction between *Goniatites, Ceratites,* and *Ammonites,* than between the last named genus and *Hamites* or *Baculites* for example, assuredly has no claim to be considered a natural grouping. In the arrangement given in the text, the second family is merely a provisional one, rendered necessary by our still imperfect knowledge of its included forms.—E. J. C.

7. Aturidæ :—Aperture open. Septa lobed. Siphuncle internal or nearly so, and very large. *Aturia* (*Megasiphonia*)—a Tertiary form.

8. Goniatidæ :—Aperture open. Septa with angular lobes. Siphuncle external. *Goniatites* (*Aganides ;*) *Bactrites.*

9. Ceratidæ :—Aperture open. Septa with denticulated lobes. Siphuncle external. *Ceratites ; Baculina.*

10. Ammonitidæ :—Aperture open. Septa foliated. Siphuncle external. *Ammonites ; Crioceras* ; *Scaphites ; Ancyloceras ; Toxoceras ? Hamites ; Ptycoceras ; Baculites ; Turrilites ; Hellicoceras ; Heteroceras.*

Under the name of Heterosiphonidæ, we have separated from the Nautilidæ, all of those more or less imperfectly known forms (commonly classed with *Orthoceras*) which possess a large complicated siphon, or in which with other related characters, the siphon is marginal. We are fully aware that many objections may be urged against this view, but until a true nautilus be discovered with the peculiar character of siphuncle exhibited by Ormoceras for example, we feel justified in holding to the separation of this latter form, with Endoceras, &c., from the normal Orthoceratites. The external ridges on the siphuncle of Endoceras, although so distinctly pointed out by Hall, appear to be forgotten altogether in the descriptions of many European palæontologists. Ormoceras, notwithstanding the central position of its siphuncle, is evidently closely related to Gonioceras; and through that genus, though less closely, to Endoceras.

If the separation of the Goniatites and Ceratites from the Ammonitidæ be disapproved of, they may be placed in that family as separate tribes. Our present object, however, is not to discuss the classification of the chambered cephalopods, but to point out the occurrence in our Silurian rocks of a type hitherto unannounced below the Devonian formation.

In the fifth of the above families, that of the Cyrtoceratidæ, characterised by the presence of simple septa with external or so-called "dorsal" siphuncle, we have three genera: *Cyrtoceras*, a simply "horned" form, exceedingly abundant; Gyroceras, a discoidal or "rolled-up" cyrtoceras, but without contiguous volutions; and *Cryptoceras*, likewise a discoidal form, but with contiguous whorls. Of the last named genus, founded by D'Orbigny, but two species appear to have been hitherto recognised: the *C. subtuberculatus* (*Nautilus subtuberculatus*) from the Devonian beds of Nassau; and the *C. dorsalis* (*Nautilus dorsalis* Phil.) from the carboniferous

limestone of Yorkshire. Quite recently, however, in a specimen from the Black River limestone of Lorette in Eastern Canada, submitted to us by Mr. Head of the Canadian Institute, we have remarked the cryptoceras type of structure, viz : simple septa and an unmistakably "dorsal" siphuncle, combined with a nautiloidal form of shell. Hall, in the first volume of his "Palæontology of the State of New York" figures and describes under the name of *Lituites undatus* a fossil that may perhaps be identical with the one now under review ; but if so, the generic term "Lituites" should certainly give place to that of "Cryptoceras." The siphuncle is said to be *dorsal;* and Professor Hall describes the only examples known to him, as occurring in the Black River limestone of Watertown, in Jefferson County. This same *Lituites undatus*, is quoted by D'Orbigny in his "Prodrome" and also by, Pictet in the last edition of his "Traité de Paléontologie ;" but these paleontologists appear to ignore completely the dorsal position of the siphuncle as described by Hall. D'Orbigny indeed, places it immediately under the following generic definition. "LITUITES, Breynius : coquille spirale, à tours contigus, siphon central ;" and this central position of the siphuncle as an essential characteristic of *Lituites*, is also recognized by McCoy in his recent work on the British Palæozoic Fossils of the Cambridge Museum, as well as by all modern palæontologists. One thing therefore is certain, that whether or not our specimen be identical with that of Professor Hall, it has evidently no claims to be considered a Lituites. In the present note, however, we are unable to do more than announce the occurrence of the genus Cryptoceras in our Canadian rocks : the characters of the solitary specimen before us being too imperfect to warrant the bestowal of a specific name.

*** Since the above was written, we have learned that several examples of this fossil type, under the name of *Lituites undatus*, have been obtained by the Geological Survey of Canada from the Black River limestone of Lorette. It is very probable that many of the Silurian "Lituites" will prove when more closely examined, to belong to Cryptoceras, or to Barrande's new genus, Nothoceras : a notice of which (Bulletin de la Société Géol. de France, T. XII. p. 380,) has only just reached us. Although stated to have been read before the Society on the third of March, 1856, the Bulletin containing the notice was not issued until March in the present year.

In Nothoceras, the bent edges of the Septa (the *goulot* of the French palæontologists) protecting the Siphuncle, instead of being deflected backwards as in Nautilus, Cyrtoceras, &c., are deflected forwards, or towards the opening of the shell, as in the Ammonites.

ON SIR DAVID BREWSTER'S SUPPOSED LAW OF VISIBLE DIRECTION.

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Read before the Canadian Institute, March 7th, 1857.

Sir David Brewster claims to have proved experimentally, that, in monocular vision, whatever be the direction in which a ray strikes the retina, it gives the sensation of vision in a direction perpendicular to the retina at the point of excitement. This is his Law of Visible Direction. A careful examination of the eye has shewn that the retina and the cornea have a common centre (which may, therefore, be conveniently termed the centre of the eye), and that a normal to the retina at the point where the picture of a small visible object is formed, almost exactly coincides (at least in pencils of moderate inclination to the axis of the eye) with the line joining the centre of the eye and the object; so that according to the Law of Visible Direction, a small object is seen in the direction (nearly) of a line drawn from it to the centre of the eye. From this law of visible direction in monocular vision, has been derived a corresponding Law of Visible Position in binocular vision; which is, that a small object seen with both eyes, appears at the point where the lines of visible direction for the two eyes meet; the meeting of these lines being a condition indispensable in order that the object may be seen single.

These laws, while admitted by some philosophers of high authority, have been called in question by others, though I have never seen any thing like a satisfactory refutation of the arguments advanced by Sir David Brewster in support of his theory. I agree with those who deny that Sir David's reasoning is valid; and I propose in the present communication to shew that the experiments on which he relies are quite inconclusive; in doing which, it will be sufficient to discuss the case of monocular vision; for, since the law of visible

position in binocular vision is professedly derived from that of visible direction in monocular vision, it follows that if the latter be destitute of evidence, the former must be given up likewise.

Sir David Brewster has no where formally explained what he means by visible direction; at least he has not done this in those papers in the Philosophical Magazine, which are expressly devoted to the proof and illustration of his Law; in consequence of which, the real import of the Law is involved in considerable doubt. But probably Sir David would accept the following as a true statement of what he holds, viz.: that the mind, being mysteriously united with the retina as part of the living organism of the body, is immediately cognizant of the affections excited in the retina; and that it refers the affections of which it is thus cognizant to a stimulus situated in the direction of a normal to the retinal surface. A writer in the Athenæum for February 7th, of the present year, thus states what he supposes to be Sir David's theory: "The mind, residing as it were in every point of "the retina, refers the impression made upon it to a direction coin- "ciding with the last portion of the ray that conveys the impression.' This is undoubtedly a mistake. Instead of: *refers the impression to' a direction coinciding with the last portion of the ray that conveys the the impression*, the statement should have at least been: *refers the impression to a direction perpendicular to the retina at the point where the refracted ray falls upon its surface.* With this alteration, the sentence quoted would substantially agree with what I have expressed. Now it is important to observe at the outset, that, even if it be true that the mind "residing as it were in every point of the retina," or, to use a less objectionable mode of expression, mysteriously united with the retina as part of the living organism of the body, is immediately cognizant of the retinal affections, this is a metaphysical truth, which does not admit of being experimentally demonstrated. It must be established by its proper evidence: and this is of itself enough to shew that Sir David Brewster, in fancying that he has experimentally proved his law of visible direction, must be labouring under some delusion. From the nature of the case, physical experiments are inadequate to establish a law whose necessary basis is a metaphysical principle.

Passing this, however, let us proceed to examine Sir David Brewster's experiments The following is perhaps the most beautiful and plausible of the *direct* experiments on which he relies in support of his Law: "Having expanded the pupil by belladonna, look directly "at a point in the axis of the eye. Its image will be formed by a

" cone of rays variously inclined from 85° to 90° to the surface of " the retina. While the point is distinctly seen, intercept all these " different rays in succession, and it will be found that each ray gives " vision in the same direction, the visible point retaining its position. " Hence it follows, that on the part of the retina in the axis of vision, " all rays, however obliquely incident, give the same visible direction " perpendicular to the surface of the membrane." Now, I admit that a very interesting fact in vision is here proved: and let Sir David Brewster have the credit of having established it. But what is the fact proved? It is, that all rays falling upon the part of the retina which lies in the axis of vision, *give rise to the same subjective affections*, whatever be the inclination at which they impinge upon the retina. Nothing else than this is made out. Sir David Brewster indeed thinks, that, because the visible point retains its position while the different rays in succession are intercepted, we are warranted in affirming that "each ray gives visible position in the same direction." But what is meant by the visible point retaining its position? There does not exist any visible point, or image, to which position in absolute space, apart from the mind, can be ascribed. When a visible point, therefore, is said (popularly) to retain its position, the idea really intended to be conveyed, must be, that no appreciable alteration is experienced in the subjective affections of which we are conscious. If we refer (as we are under no necessity of doing) our subjective affections to a remote stimulus, it is of course to be expected, that, while no appreciable change takes place in the subjective affections, no wavering or variation shall occur in the estimate which the mind forms of the direction of the stimulus. But the circumstance of "the visible point retaining its position" indicates nothing whatever regarding such reference, whether determinate or variable. A visible point is a subjective phenomenon. A change in its position is a change occurring in a subjective sphere. The absence of any change in its position is the absence of (appreciable) change, in a certain respect, in our subjective affections. The experiment described merely shews, therefore, that all rays falling upon the part of the retina in the axis of vision give rise to the same subjective affections; and hence it has no weight in demonstrating the law in support of which it is adduced.

But besides failing to observe that the circumstance of the visible point retaining its position while the different rays in succession are intercepted, amounts to no more than this, that rays incident upon the same part of the retina at different obliquities give rise to

the same subjective affections, Sir David Brewster has committed the glaring impropriety of assuming that an object in the axis of vision is seen in the direction of the axis. For how does he argue? "Each ray gives vision in the same direction, the visible point retain-"ing its position." Let this sentence pass, dubious as it is; and what next? "It follows, that, on the part of the retina in the axis "of vision, all rays, however obliquely incident, give the same "visible direction, *perpendicular to the surface of the membrane.*" Indeed! How does this follow? Grant that the rays in question all give the same visible direction (though the only thing proved, is, that they give rise to the same subjective affection); *how does the idea of a direction perpendicular to the surface of the membrane creep in?* The cone of light through which vision is produced, contains a line of rays, no doubt, which fall perpendicularly upon the eye, and pass to the retina without refraction; and it may be fancied that these at least "give visible direction" in the axis of vision. But how can such a thing be proved? How does it appear, that, when rays come to the eye along the axis of vision, the mind determinately refers the subjective affections occasioned by such rays to a remote stimulus, situated somewhere in the axis? Let E represent the eye, and O an object towards which the axis of the eye is turned. It may perhaps be said, that, if you ask the observer, he will tell you that he refers, and cannot help referring, his sensation to a stimulus in the line E O. But he means nothing more by this, than that he is unable, while his eye is turned towards O, to alter the character of the perception realized. That nothing more than this can be intended, and that there is not, in truth, any intuitive or instinctive reference to the direction E O, is rendered certain by a consideration which shall afterwards be more fully brought out, viz: that the object O is not an object of intuitive knowledge at all. Distant objects can only be known mediately or inferentially. And if the object O be not immediately known even as existing, it follows, *a fortiori*, that the direction E O is not immediately known; so that an instinctive, intuitive or immediate reference of a visual impression to the direction E O, is an absurdity.

This may suffice, as regards *direct* demonstration. *Ex uno disce omnes.* No direct demonstration can possibly indicate any thing else than the similarity or dis-similarity (as the case may be) of the subjective affections produced by rays impinging upon particular parts of the retina. Let us proceed to consider next whether Sir David receives any more effectual support for his doctrine from the *indirect*

method of proof—the method which, beginning with a certain hypothesis, and deducing the results to which it leads, concludes from the harmony between these results and actual fact, that the hypothesis is correct. And here again, as I intend to limit myself to a single example, I shall choose the most elegant and specious that I can find.

Many writers on vision have perplexed themselves with the enquiry: why are objects seen erect, when their pictures on the retina are inverted? Sir David Brewster tells us that this is a necessary consequence, and therefore a confirmation, of his Law of Visible Direction. "The phenomenon," he writes, "of an erect object from an "inverted picture on the retina, which has so unnecessarily perplexed "metaphysicians and physiologists, is a demonstrable corollary from "the law of visible direction for points. The only difficulty," he adds, "which I have ever experienced in studying this subject, is, "to discover where any difficulty lay."

In examining this statement, I would repeat the remark previously made, that the image or "phenomenon" of an object has no existence in absolute space, apart from the mind. No doubt, the language familiarly employed in treatises on vision tends to suggest a contrary idea to careless and unreflective readers; and few philosophers are at less pains to avoid phraseology liable to be misunderstood, than Sir David Brewster himself. He not only at one time, tells us of an image being formed in front of a wall, or behind a wall, according to the circumstances of the experiment; and, at another time, speaks of images floating in the air at a distance of so many feet from the eye; but he even accuses certain images of assuming a position in space different from "their right position" But, of course, such language—whatever be its meaning—cannot signify that images do ever actually exist in space, apart from the mind. I do not affirm that images are *purely* subjective states: modes of the *ego* considered *per se*, and out of all relation to matter: modes in which the *ego* might have existed, though matter had never been. Most metaphysicians take this view. A different opinion, however, may be maintained. It may be held that an image is *not* a *purely* subjective state, but is constituted by the mind's immediate apprehension of the *non-ego;* that it is a product of two factors, the mental and the material, mysteriously united with, or existing in relation to, one another. Being desirous to avoid metaphysical discussion as far as possible, I shall not attempt here to judge betwixt these two opposite theories. But, whether the one or the other be correct; whether an image be purely subjective, or partake partly of the subjective and partly of the objective; this

at least is certain, that it is subjective in such a sense that it has no existence in absolute space, apart from the mind.

This explanation being made, we are now able to estimate aright Sir David Brewster's reasoning. Suppose rays from an object X Y to fall upon the retinal surface $y\ x$; the rays from X being brought to a focus at x: and those from y being brought to a focus at y.— Sir David argues, that, according to his law, an impulse on the retina at x gives vision in a direction perpendicular to the retina at x; and that an impulse on the retina at y gives vision in a direction perpendicular to the retina at y; and that, therefore, the phenomenon of an erect object is produced, though the picture on the retina is an inverted one. But "the phenomenon of an erect object," it must be kept in view, is not any thing having existence in space apart from the mind, and standing in an erect posture. It is a subjective (I do not say, *purely* subjective) representation. Now I presume that Sir David Brewster does not wish us to believe that *this subjective representation itself* is a corollary from the law of visible direction. He cannot mean more than that the mind's instinctive and determinate reference of the affections of which it is conscious to an erect exterior stimulus, is a corollary from the law of visible direction. And undoubtedly this reference is a demonstrable corollary from the law. But is it not plain, that, to assume that there is such a reference, instinctive and determinate, involved in, or connected with, the phenomenon of an erect object, is to assume the very thing about which there is any controversy? For what is it which those demand, who ask proof of the law of visible direction? They demand proof of the assertion, that the mind instinctively refers its visual affections to a remote stimulus lying in any determinate direction whatever from the point of the retina excited.

Should the above criticisms be well founded, they are applicable to the whole of Sir David Brewster's reasoning; so that it is unnecessary to examine the details of other experiments to which he appeals. Our conclusion, therefore, is, that both his direct and his indirect proofs are entirely destitute of weight. *The sole fact which he has established, is, that the subjective affections to which rays impinging on the retina give rise, are the same, whatever be the obliquity at which the rays strike the retina.*

It is a curious circumstance that Sir David Brewster was anticipated in his Law of Visible Direction by a conjecture of D'Alembert, founded upon the idea that the stimulus proximately affecting the retina, acts, conformably to ordinary mechanical principles, in a

direction perpendicular to the retinal surface. "The celebrated D'Alembert," Sir David himself writes, in an article published in the Philosophical Magazine for May, 1844, "maintains that the action of "light upon the retina is conformable to the laws of mechanics; "and he adds that it is difficult to conceive how an object could be "seen in any other direction than that of a line perpendicular "to the curvature of the retina at the point of excitement.'—The opinion here expressed was abandoned by D'Alembert in consequence of conclusions to which he was led from the erroneous data with which he was furnished as to the structure of the eye; but, as the consideration which seemed to him to give an *a priori* likelihood to a law of visible direction identical with that which Sir David Brewster supposes himself to have experimentally established, may perhaps be thought by some to possess a measure of weight, I would observe that neither D'Alembert's conjecture, nor the inference which he drew from it, is in the least degree warrantable. On the one hand, it is by no means to be admitted that the action of light upon the living nerve, where the objective and subjective meet together, must, as a matter of course, take place according to the ordinary mechanical laws that prevail within a strictly objective sphere. And, on the other hand, even were that allowed, it would furnish no presumption in favour of the idea that we see objects in a direction pependicular to the surface of the retina at the point of excitement. For who does not perceive that the question as to the direction to which the mind refers the stimulus that produces vision remains entirely undetermined, whatever be the conclusion we adopt as to the direction in which the retina is impressed?

Not only has Sir David Brewster failed in proving his law of visible direction, but it may without difficulty be shewn that the mind does not instinctively refer its visual affections to a remote stimulus lying in any determinate direction whatever from the point of the retina excited, so that *no definite Law of Visible Direction exists.* This view, and also the ground on which it rests, were hinted at in a previous part of the paper; but it may be proper to bring it out more fully. It is based on the elementary metaphysical distinction between immediate and mediate knowledge: immediate knowledge being realised, when a thing is known in itself; and mediate, when a thing is known inferentially, through means of something else. Now, when the mind refers an affection of which it is immediately cognizant, to a remote stimulus, the judgment of the mind assigning a perpendicular direction or position to the stimulus, is mediate. No immediate,

intuitive knowledge of the position of any remote stimulus is realised : we only infer its position from the particular consciousness of which the mind is the subject. Suppose, for instance, that the eyes are directed to a small luminous object at a little distance. A remote stimulus is not intuitively known *even to exist.* Dr. Reid, indeed, the founder of the Scottish School of Philosophy, taught that distant objects are immediately perceived : but this doctrine will no longer find a single intelligent defender. As Sir William Hamilton has pointed out, Reid here fell into a fatal inconsistency. Those metaphysicians who believe that material objects have an existence at all, apart from the mind, are now unanimous in admitting that distant material objects, like the luminous point referred to, are not immediately perceived ; and I presume that Sir David Brewster would himself subscribe to this view, when formally presented to him. This leads at once to the result, that the visible position of a distant object is indefinite ; for, the estimate which we form of the position, or of any of the relations, of a thing not immediately known, is liable to variation. Different persons, and even the same person at different times, may form extremely different estimates of the position of a point. But if visible direction be thus indefinite, it cannot be capable of being expressed by a definite law, either that of Sir David Brewster, or any other.

It might be thought, indeed, from a superficial view of the subject, that, in opposition to what has been said, impressions made upon the retina *are* determinately referred to particular directions. Is not every one, it may be asked, familiar with the fact that objects often appear where the observer knows them not to be, and where, nevertheless, he cannot help fancying them to be ? An object is known to be at A. The sense of touch assures us that it is so. Yet it appears to be at B. We are obliged, in spite of ourselves, to refer the visual impression to a stimulus in the position B, though our reason is satisfied that such reference is erroneous. No effort, as Sir David Brewster says, in describing a case of the kind, is sufficient "to dispel the illusion." Does not this prove that impressions made upon the retina *are* instinctively referred to particular definite directions ? I answer : no. Take the simplest of all examples. To an observer looking at an object reflected from a plane mirror, the image appears (to speak popularly) behind the mirror. Now here undoubtedly a determinate effect is produced ; an effect which no knowledge possessed by the observer, nor any effort of his will, can modify. But what is this determinate effect ? It is *the image formed ;*

and (as was previously pointed out) an image is a subjective phenomenon — not, perhaps, purely so, but subjective at least in this sense, that it has no existence in space, apart from the mind. In granting, however, that the observer cannot by any effort modify *the image*, or subjective phenomenon, connected with a particular impression made upon the retina — which is just granting, in other words, that he cannot make his perception any thing else than it is—we by no means grant that experience does not enable him to modify *his reference of the visual impression to a remote stimulus*. A child, or a savage, who had never seen a mirror before, would naturally refer the sensation of which he was the subject, to the influence of an object actually existing behind the mirror: but when a very little knowledge was obtained, such reference would no longer be made. And here let me remark that it is not true that, in matters of vision, we ever labour under illusions which refuse to be dispelled. When a child or savage sees an object reflected from a mirror, and concludes that the remote stimulus of vision is behind the mirror, two things must be distinguished: first, the image formed, in other words, the subjective phenomenon produced, or the consciousness realized; and secondly, the inference drawn, viz: that an object exists behind the mirror.—As far as the former of these is concerned, there is no illusion. The image is apprehended as it really is. To deny this, would be to say that a perception might be what it is not. In the latter point—the inference drawn—there is certainly room for mistake or illusion; but the erroneous inferences of an uninstructed observer are capable of being corrected.

I shall only add, that, should the views advanced in this paper prove to be well founded, they must materially affect the conclusions at which we arrive on some questions which have recently excited considerable discussion. I refer to the principles involved in the construction of the Stereoscope; to our (so-called) perception of relief; to the curious changes which often seem to take place in the solids represented by plane outline figures; and to other matters of like description, into the particular discussion of which it would be beyond our present purpose to enter.

NEW TRAVERSING STAGE FOR THE MICROSCOPE.

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Read before the Canadian Institute, 21st February, 1857.

The high position now occupied by the microscope, both as an instrument of scientific research and as a means of obtaining useful recreation, as well as the great attention given to it, in order to bring it as near as possible to perfection, render unnecessary any apology from me in bringing under the notice of the Canadian Institute what I conceive to be an improvement in the construction of the stage, or the apparatus used for holding the object while under examination, and for moving it about so as to bring at pleasure any portion of it into the centre of the field of view. The importance of being able to move the stage plate of the microscope in every direction easily and with precision, is well known to every microscopist, and many methods of doing so, each having its own peculiar merits or defects, have been adopted.

In 1831, Mr. Cornelius Varley constructed the first microscope with a lever stage movement, for which he subsequently received the gold Isis medal, awarded to him by the Society of Arts of London.—But the application of the lever in Mr. Varley's microscope was soon found to be objectionable, its fulcrum was attached to the stage itself, and the lever projected downwards under it. thus removing the hand to a considerable distance from the focus adjustment, while the whole arrangement was complicated. It was however, subsequently much improved by Mr. Alfred White, who simplified very much the whole stage movement, and entirely dispensed with a great deal of what encumbered Mr. Varley's. Instead of having it below the stage, Mr. White brought the lever above, and placed its fulcrum on a stout arm projecting from the upright which carried the compound body; and in this form the lever stage is still mostly used—this stage is described by Mr. White in the first volume of the Transactions of the Microscopical Society. It consists like almost all traversing stages, of three plates of brass laid one above the other, the lowest one being fixed and the other two provided with dovetailed guides and slides, so that each may be

easily moved by the lever either in the same or in parallel planes, but at right angles to each other; while if both be moved at the same time, a diagonal motion is obtained at the pleasure of the operator.

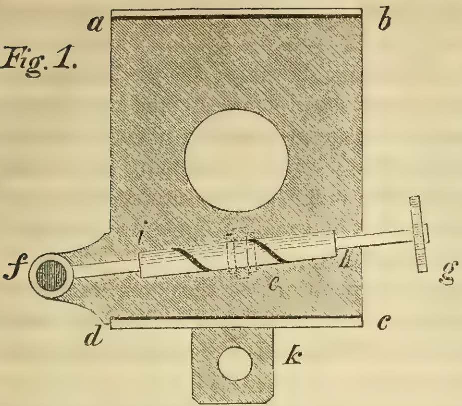
This plan of a traversing stage has many advantages, it is in the first place simple in its construction, and is very easily managed—and as the end of the lever to which the hand is applied moves in all cases in exactly the opposite direction to that in which the stage is moved by it; and as the compound microscope always inverts the image of the object under examination, the object will appear to move in the direction of the hand. But the great objections to this form of the traversing stage, are that the lever is very much in the way, and being attached to one of the extreme angles of the stage, when, it is in use, the strain is thrown more upon those parts of the stage in the vicinity of the lever, which wear away more rapidly than the others, and soon impair the correct working of the instrument.

The next mode of producing a traversing motion, is that usually known as Turrell's plan, and is described by that gentleman in the 49th volume of the transactions of the Society of Arts. In this mode the lever is entirely dispensed with, and the different motions are communicated to the stage plate, by two milled heads placed together, at the right hand side of the stage, and turning upon concentric axes. The motion of one of the plates of the stage is produced by turning one of the milled heads attracted to a pinion which works in a rack attached to the under side of the plate. The motion of the other plate is produced by the other milled head which works a screw, in a thread attached to the under side of the second plate; and by working the two milled heads at the same time, a diagonal motion is given to the stage. But apart from the complexity of this arrangement and its great liability to get out of order, it has several very serious defects, the greatest one being that in order to produce a diagonal motion in some directions it is necessary to use both hands, an objection which this form of stage was expressly designed to meet, but which it only partially removes.

In the microscope which I have now the honor to bring under the notice of the Canadian Institute, this difficulty is entirely overcome, and by a combination of the lever and the screw, the advantages, without the defects, of both Mr. White's and Mr. Turrell's plans are secured.

I have placed immediately under, and running the whole way across the stage, the lever *f g Fig.* 1. on which for about two inches

Fig. 1.



of its length, at an equal distance from either end of it, is cut a spiral groove, *h i*. The fulcrum is at *f* on the left side of the stage in a small pillar rising out of a slight projection from the lowest plate of it, and is so contrived, that the lever can be easily turned on its own axis. On the other end of this lever at *g* a milled head is fixed, by which the different motions are given to the lever. An enlarged representation of the adjustment for the fulcrum is given at *Fig.* 2., representing a small brass pillar, which passing through the under plate of the stage, is held down by a forked piece of brass screwed to the under side of the plate, and accurately fitting the neck cut in the pillar at *o*, so that the pillar can readily be turned on its own axis while firmly held in its place. The end of the lever having a similar neck, is shown at *m*; this fits into the pillar and is held in its place by a small forked piece of iron, *n*, passing down over the neck, and secured by the small screw *p*. The grooved part of the lever passes through a short brass tube, *e* (*Fig.* 1.,) (an enlarged

Fig. 2.

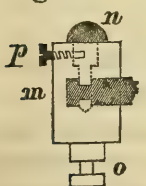
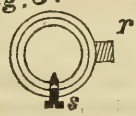


Fig. 3.



representation of which is given at *Fig.* 3.) to this tube a small stem *r* is attached, which screws into the under side of the upper stage plate by a left handed screw, a small steel screw *s* passes through the tube, the point of which fits into the spiral groove *h i* of the lever. The upper stage plate slides in dove-tailed grooves made in a frame of brass, and this frame slides in the dove-tailed grooves at *a b* and *d c* but at right angles to the former. The arm which carries the compound body rises from the projection shown at *k*; by turning the milled head *g* the action of the spiral groove on the pin in the tube *e* moves it, and with it the stage to which it is attached, to or from the hand; while by moving the milled head backward or forward, a transverse motion is produced, and by com-

bining the two, a diagonal movement at the will of the operator is secured.

The advantages of this plan are simply these: 1st, the lever is not in the way of the operator, yet very easy of access, and the power is applied as near the centre of the stage plate as it is possible for it to be. 2nd, only one hand can in any case be necessary to produce every motion that may be desired; and 3rd, it is very simple, is not liable to get out of order, and if it should happen to get out of repair can readily be set right again.

I may perhaps be permitted to point out another improvement in this instrument, which has lately been introduced in England, and I believe also in the United States. This consists of a new arrangement for the coarse adjustment of focus.

The rack and pinion movement which is always unsteady and works by jerks even when most carefully constructed, is here dispensed with, and instead of it a chain movement is substituted, which has the advantage of being much smoother, and more sensitive, of being less likely to become unequal by wear, and of being easily tightened if it should cease to act, or "loose time" as it is technically called, while its delicacy and smoothness admit of an exact adjustment being made by its means alone, even when using high powers.

REVIEWS.

Gales in the Atlantic: By Lieutenant Maury, U. S. N., Washington Observatory, May, 1857.

In extending a knowledge of the physical phenomena of the Atlantic Ocean, the publications of the Washington Observatory under the able superintendence of the author of the "Physical Geography of the Sea," stand deservedly pre-eminent. Lieutenant Maury's *Wind and Current Charts*—an annual volume of over nine hundred quarto pages accompanied by a large number of ingenious and elaborately executed maps—are universally allowed to have contributed the most essential aid to navigation. As Humboldt truly states, the shortening of many a dreary voyage may be cited as one of their results. In that valuable publication, the gales of the Atlantic are especially discussed; and various explanatory

diagrams are given in illustration of their peculiarities of occurrence. In the publication now under notice, this subject is still further elaborated; and we are presented with a chart of the North and South Atlantic Oceans, for each month of the year, shewing by an ingenious arrangement of colours, the comparative frequency of gales, over given areas, in the different months. Three facts are brought strikingly before us by an inspection of these gale-charts. First, the marked preponderance of stormy weather generally in the North, as contrasted with the South Atlantic, at least for the winter months; secondly, the scarcity of gales between the parallels of 30° north and south; and thirdly, the remarkable difference between the frequency of gales in the winter, as compared with the summer months, over that region of the North Atlantic lying more especially in the track of ocean travel between the United States and Europe. Whilst in the October, November, December, January, February, March, and April charts, an extended and unbroken line of colour stretches from the British Isles to the Atlantic sea-board of the States only varying somewhat in intensity and breadth—in the June, July, and August charts, merely a few limited patches meet the eye. In his brief explanation of these charts, Lieutenant Maury states that they were principally worked out with a view to ascertain the most tranquil and favorable time for laying the sub-Atlantic telegraph. This time, and necessarily also the most favorable season for passenger travel across the Atlantic, he shews to be about the end of July, or the beginning of August. "At no season of the year," writes Lieutenant Maury, "can the passage around either of the 'Stormy Capes,' as poets call them, vie for storms with the winter passage between England and America." And again, "this part of the ocean is most tranquil in summer. Taking averages, we have in it fewer gales but more fogs and ice in June than in July or August; but fewer fogs and least ice in August. The last of July and first of August appears to be the most favorable time for laying the sub-Atlantic telegraph. This information may be useful to invalids and others crossing the Atlantic, as well as to those engaged in this enterprize."

Although these gale-charts are intended to be considered in the light of approximations merely, some idea may be formed of the care bestowed on their compilation, when we state that they embody the results of no less than 265,292 days of observations.

E. J. C.

Journal de l'Instruction Publique : Montreal, (Bas-Canada,) 1857.— Nos. 1, 2, 3 and 4.

Journal of Education: Montreal, (Lower Canada,) 1857. Nos. 1, 2, and 3.

We notice with great satisfaction the nearly simultaneous appearance of the two educational journals of Lower Canada: each, as we trust, and fully believe, the *avant courier* of a new era for educational progress in that part of the Province. They appear as the organs of the improved Common School system of Lower Canada, now established with its twin Normal Schools at Montreal, the McGill and the Jacques Cartier Schools; and at Quebec the Laval Normal School; all under the efficient control of the Hon. Pierre J O. Chauveau, Chief Superintendent of Education for that part of the United Province.

It argues well for the success of the newly inaugurated system that an honest attempt is thus being made to adapt the educational system, not only to the wants, but also to the opinions and prejudices of the two very diverse elements which constitute the combined population of that portion of British North America, instead of attempting any forced and unattainable theoretic uniformity. The two journals thus addressed to different sections of the population, who are being trained under systems diverse in some important respects, and with different languages, historical associations, and aims: are designed each with a view to their own special readers; while, nevertheless, they have much ground in common, and cannot fail to exercise a beneficial and stimulating influence on each other. That they are to move in harmonious combination is the present purpose of their editors, and in this worthy aim we wish them all success. The editor of the English journal, after detailing the design and objects of the work, and stating the varied contents with which it is purposed to fill its pages, thus concludes his first leading article, speaking in part for both journals:

Every thing congenial with public instruction will find its place in our columns, varied we hope in the most pleasing manner. Poetry will now and then lend us its harmonious accents. Science in its innumerable departments will afford us amusement and instruction. History, and more especially that of Canada, will frequently unfold an interesting page to our young readers. The passing events of our day, without any allusion to local politics will teach us many a lesson, and finally Religion that aromat (as a great English chancellor had it,) without which all science would be putrified, religion we hope will pervade all our writings, and by its sacred influence will exclude from our columns anything that might offend the eye even of the most scrupulous of our readers. With the help of these powerful elements, and we hope, with the assistance of all the friends of education, "Le

Journal de l'Instruction Publique," and the "Lower Canada Journal of Education," will be enabled to accomplish the all important mission confided to them.

That mission, difficult in any country, is rendered more so in ours, by the complications which difference of language, origin and creed, bring with them in every public undertaking. These, however, we hope not only to surmount, but we are sanguine enough to see in them if properly attended to, new elements of success. Amidst the furious struggles of the political world, all sections of the population require a neutral ground where they can meet for one common object, with one common accord. This can no where be found but in education, in science, and in literature, and presents little difficulty with us in Lower Canada, from the fact, that through mutual forbearance, education has never been the cause of either political or religious dissension.

It will be one of our chief objects to make each section of the population better known to the other, and to spread useful information through the means of each of these journals, on the educational progress not only of its own class of readers but equally of those of the other. Having at our disposal a large supply of English and of French newspapers and periodicals, as well from the old world as from our own continent, we shall be enabled, with the aid of appropriate translations to offer to the readers of each of our papers, matter that is not generally within their reach. We will endeavour from these sources to diversify the columns of both publications and render them entertaining to all; and we may add, that to our knowledge, a great number of families who are acquainted with the two languages will become subscribers to both. This fact will of course increase our responsibility and stimulate our exertions in relation to each of the two journals.

Under two different names, clothed in two different languages, but both harbingers of peace, both advocates of the same cause, we send forth these two papers, and with care, with fondness, with anxiety alike for both, for both we ask—and to both, we trust the public will say—success.

To this desire we heartily respond. Education universally diffused among the people of Canada is an indispensable element to its true progress; and the rapid advances we are now making in agricultural and commercial prosperity, render such not less, but more indispensable, if we would not sink into mere trading and labouring drudges with no higher ambition or nobler aim in life than that of Bunyan's "Man of this World," shown to Christiana and the boys in the "Significant Rooms" of the Interpreter's House. The quaint fancy of the glorious old Dreamer's parable is replete with lessons for all of us in these days and this land, where the one object of life so often seems the mere haste to get riches. "The Interpreter takes them apart, and leads them into a room where was a man that could look no way but downwards, with a muck-rake in his hand; there stood one also over his head with a celestial crown in his hand, and proffered him that crown for his muck-rake: but the man did neither look up nor regard, but rake to himself the straws, the small sticks, and dust of the floor."

Some such *significance* both the Educational Journals of Lower

Canada seek to set forth in the teaching they inaugurate. The "Celestial Crown" which he who is engrossed by the raking together of the world's dust and straws cannot discern, is not indeed mere intellectual culture, though that unquestionably has an elevating tendency. It raises men's thoughts, uplifts their aspirations, and precludes in some degree the all absorbing sovereignty of mammon's worship.

The motto of the English Journal is: "*Labor vincit omnia,*" that of the French Journal: "*Rendre le Peuple meilleur,*" but both exhibit their chosen *cri de guerre* encircled by the Canadian emblems of the beaver and the maple-wreath; within which, and resting against the symbol of our common christian faith, is the open volume, inscribed: "religion, science, liberty, progress," as the means which—notwithstanding the differences separating those of English and French language and origin from each other,—they thus acknowledge to be, each and all of them, indispensable as the allies and coadjutors of national education, by which all difficulties must be overcome, and all obstacles removed which would hinder the making of the people better. That these, the true elements of a people's greatness and prosperity, may advance simultaneously as the fruits of the great blessing of a wise national education throughout every section of our Province, is, and must be the earnest desire of every one who believes that the "people are destroyed for lack of knowledge;" but that "righteousness exalteth a nation, and sin is a reproach to any people."

We would gladly see both of these Journals obtain an extensive circulation in our upper section of the province. The more we learn to take an interest in all which pertains to the welfare of each other, the better will it be for our common country and the success of all in the progress of which we have a mutual advantage to reap, and we gladly cherish the belief that the common ground on which we can meet and exchange sympathy is neither narrow nor straightened. Views of the Jacques Cartier Normal School, illustrate the first number of the one Journal, and of the McGill Normal School the other. Already papers are introduced as the first of a series, on questions interesting to all engaged in education; while another series devoted to "the Colleges of Canada," begins with the history of Laval University, and with a view of the extensive but singularly unacademic looking range of buildings which furnish accomodation for that Institution at Quebec. This will be followed by similar notices of the other educational institutions of the Province, and is

not to be confined exclusively to Lower Canada. Incidents of early Canadian history are also introduced in a pleasing style, and addressed as these are in the *Journal de L'Instruction Publique* to those of French origin, they are presented in a form calculated to give piquancy and interest to us, who, when considering them at all, are apt to overlook some of the minuter points best calculated to awaken an interest in our historic past. Altogether we gladly welcome these Education Journals as most useful and acceptable additions to the periodical literature of the Province.

D. W.

Reid's Works, (Essays on the Human Mind, &c.,;) with selections from his unpublished letters; with a Preface, Notes, and Supplementary Dissertations, by Sir William Hamilton, Bart. Edinburgh: 1854.

The following article is not a *criticism*, but simply an *exposition* of the late Sir William Hamilton's doctrine of Sensitive Perception; and it is designed to supply what has hitherto been felt by many, and especially by those entering on the study of philosophy, to be a great desideratum: an accurate, and yet not very technical statement of the only consistent and plausible system of natural realism which is before the world. It is necessary to explain that the writer of the article considers Sir William's doctrine to be in several important respects erroneous. But without bringing forward the grounds of this opinion, he has limited himself at present to the task of exposition. The only exceptions to this, are, the foot note on the subject of the extension of body, and the reference made in the note at page 295, to a former article in this journal, on Sir William Hamilton's doctrine of consciousness.

Under the general title of Sensitive Perception, Sir Wm. Hamilton includes sensation proper and perception proper; or more simply, without the addition of the epithet *proper*, sensation and perception.

Each of these forms of sensitive perception is held to be an act of the mind in which an object is known. Sensation is allowed indeed to be a lower exercise of intelligence than perception; because, as will afterwards appear, it is merely the knowledge of a fact, while perception is moreover the knowledge of a relation: but still both are acts of intelligence. The mind in sensation, as well as in perception, is cognizing an object. This is not the universally received

doctrine of philosophers; for some have thought that sensations, as mental states, are capable of being distinguished from the acts of intelligence by which a knowledge of them is realised. In fact, it has been held, and by no mean authorities, that sensations may exist in the mind, without ever becoming known at all. But according to Hamilton such opinions are untenable. He denies that sense, either in its lower or in its higher form, can be discriminated from intelligence. "Quid erit sensus," he asks with Tertullian, "nisi ejus rei quæ sentitur intellectus?"

Sensation is not only an act of knowledge, but more particularly, one of immediate knowledge or consciousness. As we shall have frequent occasion to use these expressions, *immediate knowledge*, and *consciousness*, it may be well to define them formally. An object is said to be known immediately, when it is apprehended in itself; in contradistinction to mediate knowledge, which takes place when an object is apprehended through something else. Thus, a blind man, made sensible through means of his staff, of an obstacle before him, knows the obstacle, but only through something else. This is mediate knowledge. On the other hand, how is one aware of the thought which at any moment exists in his mind? He apprehends it, not through anything else, but in itself. This is immediate knowledge. Consciousness is employed by Sir Wm. Hamilton, and will be used throughout this article, as synonimous with immediate knowledge. When therefore sensation is represented as an act of immediate knowledge or consciousness, the meaning is, that the object known in sensation is apprehended in itself, and not through the medium of aught else.

This leads to the enquiry, what is the object of which we are conscious in sensation? Sensation is an act of knowledge; it is an act of immediate knowledge: what is the thing immediately known?

In answer to this we remark that the living organism of the body is capable of having a great variety of affections excited in it, either by external or by intraorganic causes. In the well-known theory of Dr. Reid, such affections are recognised as the antecedents of our sensations. The sensation of sweetness, for example, is consequent upon one particular modification of the animated organism; the sensation of redness upon another; the sensation of the odour of a rose, upon a third; and so forth. The sensorial affections which are thus regarded by Reid as the antecedents of our sensations, constitute, according to Hamilton, the objects known in sensation. The living organism, in consequence of the application of some stimulus, is affected in a certain way; the mind immediately knows, or becomes

conscious of the organic affection; and it is in this immediate knowledge or consciousness that sensation consists. Sensation may accordingly be defined to be an act of consciousness whereby we apprehend in our body, certain special affections of which, as an aminated organism, it is contingently susceptible.

In saying that the object of which we are conscious in sensation is an affection of the animated corporeal organism, let it be understood that Hamilton does not altogether negative the commonly received opinion, that the object of sensation is in the mind. A word of explanation is requisite here. The body, as animated, ought not in propriety to be considered external to the mind; for it exists in a mysterious connection with the indivisible thinking principle, in consequence of which, the affections of the living organism are apprehended as subjective affections. The terms *objective* and *subjective* denote, the former what is without the mind, and the latter what is in the mind. Now undoubtedly, the body, as a material organism, with the general relations of extension under which it in that character necessarily exists, is without the mind, and can only be apprehended objectively; but as a living organism, it is in union with the mind, and its affections are felt as subjective. The general relations of extension under which our bodies exist as material substances, belong to our bodies alone. They cannot in any sense be predicated of the mind. I, the Ego, do not exist under any relations of extension. But the special affections excited in my body as an animated organism, I claim as mine. I am conscious of them as affections of Self. It is only with this seriously qualifying explanation that Sir W. Hamilton would subscribe to the doctrine of Reid, and of philosophers generally, that the object of sensation is in the mind. He would not allow that it is in the mind purely. Strictly, it is a sensorial affection, which we are constrained, however, to view as of the Ego, in consequence of the union subsisting between the Ego and the living organism.

In the opinion of Reid, the dependence of our sensations upon affections of the bodily organism is altogether arbitrary. A piece of sugar is taken into the mouth; the organ of taste is affected in some unknown way; thereupon the sensation of sweetness arises. So says Dr. Reid, and he tells us that no necessary connection exists between the condition determined in the organ, and the sensation to which it is antecedent. It is a connection which has been established arbitrarily, by the will of the Creator. Had the author of our being so pleased, the sensation of sweetness might have been made to arise, not in connection with the particular condition of the body upon which it is actually consequent, nor in connection with

any state of the organism whatever, but as the consequent of some change in the planet Jupiter, or in the volcanoes of the Moon. But on the view taken by Sir W. Hamilton of the object of sensation, such an opinion is manifestly inadmissible. If sensation be, as he maintains, the immediate apprehension by intelligence of certain affections in our living bodies, the dependance of our sensations upon our organic states cannot be arbitrary. To speak of an act of consciousness without an object, would be a contradiction in terms.

Let us now turn to perception, the other form of sensitive apprehension. According to Sir W. Hamilton, perception is, like sensation, an act of immediate knowledge or consciousness; but whilst the latter has for its object, as we have seen, affections of the Ego, the former has for its object relations of the Non Ego. Is it asked: what are these relations, and how are they presented to the mind so as to be perceived? The answer is: they are relations of extension, and they are apprehended in and along with our organic affections. Here, for the sake of simplicity, as well as because the distinction requires to be made on other accounts, we shall consider separately the relations of our organism to itself, and the relations of the organism to what is extraorganic. In the first place, with regard to the relations of our organism to itself: suppose that affections locally out of or external to one another are excited in the organism by some stimulus. The mind immediately apprehends the fact of their existence; and this is what we call sensation. But in immediately apprehending affections mutually out of one another, it obtains a consciousness of the relation of mutual outness which they bear to one another; in other words, it becomes conscious of the organism as existing under relations of extension. This is perception, apprehending our body as a finite, extended—that is, as a material object.* In the next place, with regard to the relations in space of the material organism to what is extraorganic, in order to show how these become objects of perception, we must refer to a class of sensorial affections which possess a character altogether peculiar; we mean modes of resistance. In

*Sir William Hamilton defines Body to be *that which occupies space and is contained in space:* and (as the text explains) an objective reality answering to the definition is, according to him, ascertained to exist, in the consciousness which we have of affections of the corporeal organism mutually external to one another.

Now it is worthy of remark that the consciousness here described—and which is the only consciousness that is supposed to reveal the extension of matter—does *not* reveal matter or body as *continuously extended*. We offer no criticisim now on Sir W. Hamilton's general doctrine. For the sake of argument, let that general doctrine be admitted. Let it be admitted, in particular, that, when the mind perceives, it cognizes a plurality of organic affections in their relation of mutual outness to one another. Does it follow that the organism in which two such affections A and B are simultaneously apprehended is a *continuum*, a substance stretching with unbroken extension from the locus of the one affection to that of the

fact, resistance as a subjective mode will, upon reflection, be seen, (Sir W. Hamilton holds) to be a relative, having for its correlative (the consciousness of which is therefore necessarily involved in our consciousness of resistance as an organic mode) a degree of outward force or pressure opposed to our locomotive energy. A person exerting a muscular effort, and feeling that the limb which he essays to move is impeded, cannot be conscious of resistance in this phasis, as an effort of self, an organic mode, without at the same time being conscious of it in its other phasis, as a force which is not self-opposing the attempted movement of his organism. It may thus be understood how relations in space of the corporeal organism to what is extraorganic, as well as relations in space of the organism to itself, fall within the reach of the perceptive faculty. Modes of resistance are immediately apprehended in the organism, as actual phenomena; this is sensation. In and along with the immediate apprehension of the fact of their existence, comes a consciousness of the mutual relation of outness in which they stand to one another; this is perception, revealing the organism as extended. But still further, in the same indivisible act of consciousness, we apprehend our organism standing in the relation to something extraorganic, of being resisted by it; this is perception recognising the existence of extraorganic objects. We do not indeed immediately know that what resists our locomotive energy is body or matter: we only learn in course of time, mediately, through induction, to connect pressure with bodies. But even prior to induction, immediately, in and along with sensations of resistance, and the accompanying perception of relations of extension in our organism, we have a knowledge of a resisting extraorganic something—whether identical with matter, or in any way connected therewith, deponent (to wit consciousness) saith not.

We remarked when speaking of sensation, that, in virtue of the union betwixt the mind and the animated organism, the special affec-

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other? By no means. Extension is not supposed to be apprehended in the consciousness of the affections A and B as actual phenomena; but only in the consciousness of their mutual outness. If, however, neither the affection A *per se*, nor the affection B *per se*, reveals the organism as extended, then all that is fairly implied in the mutual outness of A and B, is, that the organism is plural, compound, having the locus of one element here, and that of another there—which is a very different thing from saying that it is a continuously extended substance, or composed of elements which possess continuous extension. Even though the organism of our bodies were known to exist as a congeries of elements external to one another, it might still be the case that matter did not possess extension in the proper sense of the term; in other words, matter might not be a substance in which different points could be taken, such that the substance would stretch as an unbroken *continuum* from one of them to the rest.

tions of the latter which are apprehended in sensation, possess a subjective character. They are felt as affections of self. But when we consider the general relations of extension under which the organism is perceived to exist—relations under which, as body, it necessarily exists—it is plain that as respects these, it has no claim to be viewed as subjective. They do not belong to it as united with the thinking principle, and cannot in any sense be predicated of self. Hence the organism which in sensation is reckoned of the Ego, is in perception accounted Non-Ego. This will probably seem strange doctrine to those to whom it is presented for the first time. That the organism in one aspect, as animated, and the object of sensation, should be of the Ego, while in another, as material and the object of perception, it is ignominiously reduced to the rank of Non-Ego—that it should be at once within and without the mind—may, as Sir W. Hamilton confesses, "appear not a paradox merely but a contradiction." But upon any theory, the connection between soul and body is a deep mystery—"the mystery of mysteries;" and should a particular doctrine be in other respects agreeable to the imitations of consciousness, Sir William Hamilton contends that it is not rendered unworthy of acceptance, merely by being paradoxical or even seemingly contradictory [real contradiction being always supposed to be avoided] where it touches upon a matter so obscure.

Sir William does not admit that distant objects—that is, such as are not in proximate relation to the organism—are perceived. We perceive our body (as a material organism), and also extraorganic objects (not known by consciousness to be material) directly pressing against the organism; but we perceive nothing else. And indeed a moment's reflection is sufficient to shew that no system in which perception is viewed as an immediate cognition, can, without palpable error, affirm the perception of distant objects; for such objects are not in presentation to the mind, which never sallies out beyond the organism: and the mind cannot immediately apprehend what is not in presentation to it. Here Dr. Reid is grievously in fault. His philosophy knows nothing of any such limitation of the range of the perceptive faculty as that described. He claims for perception a capacity of reaching to distant objects; and classes himself, even ostentatiously, with "the vulgar" who think that they perceive ships and houses, and men, and women, and other external realities which lie confessedly beyond the sphere of proximate relation to their organism. But this is, of course, perfectly absurd, on the supposition that perception is, what Reid every where affirms it to be, an immediate cognition. A book lies upon the table; our eyes

are directed towards it. Do we perceive it? In the proper sense of the term, assuredly not—that is, if perception be an immediate cognition. The book is not in presentation to the mind; and therefore any knowledge of it to which we attain is of necessity got mediately, as the result of the immediate cognition of some other object or objects lying within the reach of consciousness. Sir W. Hamilton, by denying that distant objects are perceived, escapes the charge of suicidal inconsistency to which his predecessor is exposed. According to his doctrine, the sun is not perceived in the firmament; its presence there is only known mediately and inferentially. David did not perceive Goliah when he was in the act of slinging the stone at his forehead; he merely *guessed*, as our American neighbours would say, founding on some particular consciousness of which he was the subject, that the giant was before him.

It will be obvious from the statement made, that sensation is the condition *sine qua non* of perception. For what is perception? It is the immediate knowledge of relations under which the organism exists, to itself, or to something extraorganic. But these relations are apprehended only in and along with organic affections. Let no organic affections be cognized — in other words, let there be no sensation—and the organism is no longer known at all; *a fortiori* its relations remain unknown. Perception therefore implies sensation as its indispensible condition. Yet it must not be supposed that, as Reid affirms, the one precedes the other in time. A sensation (Reid tells us) is first experienced; and and thereupon a conception of the external object which was concerned in originating it, together with an irresistible belief of the existence of the object, are instinctively suggested to, or inspired in, the mind. The conception and belief, forming the constituent elements of the perception, are suggested to, or inspired in the mind, on occasion of the sensation; so that the perception is subsequent, by however brief a period, to the sensation. In opposition to this, it is a perfectly essential part of the doctrine of Sir W. Hamilton, that though sensation must, indeed, as a *conditio sine qua non* of perception, be antecedent to it in the order of nature, the two are inseparable in time. The relations of extension which we apprehend in our body, when we perceive, are apprehended not after, but in and along with organic affections. It hardly requires to be added, that Hamilton's principles are diametrically opposed to those statements also of Dr. Reid, which represent the connection between sensation and perception (like that imagined by Reid to subsist betwixt our organic states and our sensations,) as arbitrary, and which affirm that

had it so pleased God, external objects might have been perceived by us, independent of sensation altogether. The dependence of the knowledge of a relation upon the knowledge of the things correlated is so far from being arbitrary, that even Divine power could not work an impossibility of giving us the former save on condition of the latter.

It cannot have escaped the notice of our readers, that perception must, on the doctrine expounded, have for its condition, not only sensation, but a plurality of sensations, because the perception of our organism (which enters into all perceptive consciousness, even into that of the extra-organic world,) is the consciousness which we have of the mutual outness of organic affections locally external to one another, and therefore plural. These affections do not indeed constitute sensation, but sensation consists in the recognition of them; so that perception can take place only where sensation is recognising a plurality of objects. Sir W. Hamilton not only holds this, but maintains that sensation itself supposes plurality in the object or objects of its apprehension. Let us quote his own words: "The second," (that is, the second condition of sensitive perception, in either of its forms; attention having been named as the first,) "is "*plurality*, *alteration*, *difference*, on the part of the perceived object " or objects, and a recognition thereof on the part of the perceiving " subject." However technical a sound these words may have in uninitiated ears, (Sir William is partial to esoteric phraseology,) the thing meant may, without much difficulty, be understood. Were the organism of our body without affections capable of being discriminated as plural, it would in fact be devoid of affections altogether; for what are affections except alterations or differences? If, therefore, sensation be the recognition of affections in the organism, it follows that where there is no alteration or plurality, there can be no sensation: as Hobbes has pointedly expressed it, " sentire semper " idem, et non sentire, ad idem recidunt." But indeed it is not in sensitive perception alone, that alteration is held to be an indispensable condition, but in every other exercise of consciousness likewise; and this, it may be remarked, is a grand fundamental principle on which Sir W. Hamilton relies, in seeking to refute those theorists in the highest region of thought, who claim for man a knowledge of the Unconditioned. The Unconditioned, including the Infinite and the Absolute, does not exist under characters of plurality or difference, and therefore, (Sir William argues) cannot be apprehended by human consciousness. Without, however, attempting to soar to such sublime speculations at present, but keeping to the *terra firma* of our

proper theme, it is sufficient to observe that the philosopher whose views we are expounding, assumes it as an axiom, that there can be no sensation and of course no perception, except on condition of plurality—plurality in this besides other respects, that the organic affections apprehended in sensation be out of, or locally external to, one another.

We are now in a position to understand the manner in which scepticism regarding an external world is dealt with by Sir William Hamilton.

Strange as it may appear to "the vulgar," (we employ Dr. Reid's familiar expression in no disrespectful sense), that any person out of a lunatic asylum should call in question the reality of external objects, and hesitate to allow the existence of the friend whom he beholds, of the food which he tastes, or of the wall against which he knocks his head, Sir William Hamilton maintains, that on any other doctrine than one of immediate perception, such scepticism not only is natural, but becomes a logical necessity. It is a first principle in philosophy that nothing should be believed, except it be known, either immediately in consciousness, or mediately by inference from data which consciousness affords. The Cartesian spirit, which doubts whatever is not established—which relentlessly bars out of the mind the most universally received maxims, so long as they seek admittance in the guise of dogmas—whose stern decision regarding every propositon affirming what is not either immediately or mediately known, is, let it be rejected: this is the true philosophic temper, not at all deserving the censure that has so often been ridiculously passed upon it, but on the contrary worthy of the highest commendation. Let, then, a student endowed with this disposition, address himself to the subject of sensitive perception, starting with the idealistic view, that we possess an immediate knowledge only of what is in our minds. How shall he proceed? Suppose that, sailing down the St. Lawrence, he is admiring the strange and beauteous spectacle of the Thousand Isles. The only thing of which he is presumed to be immediately cognizant is a mental affection, a peculiar sensation connected (the vulgar think) with the presence of certain islands. But does the vulgar opinion—he, as a philosopher, is necessitated to ask himself—rest upon a solid foundation? Are there really any islands in the case? How does he know that? Should it be suggested that the sensations excited in him must have a cause, the question will still occur, must the cause be an external one? Must it be material? May not his sensations arise from his own mental energy, unconsciously exerted? May those subjective

representations which (even after the manner of the vulgar) he is prone to ascribe to the presence of objective realities, not be merely phantasmagoria produced by the unconscious activity of the Ego, or otherwise conjured up before his mental eye? May they not be due to the direct operation of the Divine Being? Might not God excite within the individual all the sensations which he experiences, even though material objects were not? Can purely mental phenomena —phenomena which might take place though there were no such thing as matter—warrant the conclusion that matter exists? It may perhaps be urged that our observer is irresistibly impelled to believe that he is perceiving external objects; but what of that? The felt necessity of affirming the non-ego, is a circumstance both intelligible and important, as we shall presently see, on the doctrine of those who hold that the non-ego is immediately cognized; but the Cosmothetic idealist can make no use of it to serve his purpose. For *what* impels him to believe in outward objects? His very nature. After all, then, the much-vaunted necessity of believing in material realities, indicates nothing except the manner in which we are constituted, and in which we feel ourselves obliged to think. From considerations such as these, Sir W. Hamilton, in common with the most distinguished and consistent idealists themselves, maintains that if an immediate knowledge of the non-ego be denied, scepticism as to its existence becomes logically unavoidable. No better exemplification could be afforded of the difficulty of saving an external world on idealistic principles, than is furnished by Dr. Thomas Brown, whom Sir William not only criticizes mercilessly for his opinions on sensitive perception, but whom, we may add, he wonderfully delights to kick on all occasions, and who certainly is exposed, on many inviting points, to the toe of an opponent. Dr. Brown expressly avows that the irresistible belief to which we have referred, is the only thing which stands betwixt himself and Pyrrhonism. Assuming on the one hand that matter is not immediately known, he grants on the other that its existence cannot be legitimately inferred from aught that we do immediately know, but that "the sceptical argument, as a mere play of reasoning, admits of no reply." Yet forsooth, we are irresistibly compelled to believe in matter! We are irresistibly compelled to believe what we have no knowledge of, either mediate or immediate! A miserable thing would Philosophy be, were this truly the issue of her speculations. Alas! if, after she has inscribed on the portals of her temple the great idea, that only what is known is to be believed, she is found to utter as her very first oracle in the ears of her votaries, that an external world is not known, yet must

be believed, to exist! Admit that a blind faith, a faith without knowledge, is either satisfactory, or all that we can attain to, and Philosophy may break her staff. There is no longer any work for her to do.

If Sir W. Hamilton's views be adopted, scepticism in regard to an external world ceases, as a matter of course. The non-ego, according to him, is immediately known to exist. No proof of the fact is given; none is needed; we are conscious of it; and our consciousness involves its absolute certainty. Consider in what circumstances alone doubt can, by any possibility, be legitimate. Should an object not revealed in consciousness be affirmed to exist, there may be good ground for calling its existence in question; some defect may be capable of being pointed out in the evidence through which a knowledge of it is supposed to be attained; and in such a case, scepticism is not only warantable, but imperative. In regard, however, to the existence of an object revealed in consciousness, scepticism is utterly inadmissible. The data of consciousness—those primary beliefs which do not depend upon reasoning, but are the starting points from which reasoning sets out—cannot be assailed. Not only when considered simply in themselves, as apprehended facts, but also when considered as testimonies to the truth of facts, beyond their own phenomenal reality,* "they *must*," Sir W. Hamilton writes, "by us be accepted as true. To suppose their falsehood, is to suppose that we are created capable of intelligence, in order to be made the victims of delusion; that God is a deceiver, and the root of our nature a lie." Now, in Sir William Hamilton's opinion, the existence of the non ego is one of the primary data of consciousness, and therefore beyond cavil—"a chield that winna ding, and downa be disputed."—Scepticism might be possible, on the principles of Mallebranche, who seeks to prove by Scripture that a material world exists; or on those of Des Cartes, who reaches the same result through a consideration of the veracity of the Divine Being. A sceptic is at liberty, in either case, to bring to trial the demonstration offered, and to withhold his assent from the conclusion till he has satisfied himself that the proof is good. But on the principles of Sir William Hamilton, the door is shut against scepticism, for he affirms the existence of the non-ego on an authority above argument. And, though our consciousness of the non-ego does not, according to him, extend to distant objects, but is confined to the bodily organism, and to extra-organic

*The Hamiltonian doctrine of consciousness, here presented, seems liable to grave objections. For a review of it, by the writer of the present article, see Canadian Journal, N. S., vol. 1., page 379.

objects in proximate relation to the organism—though the observer, for instance, whom we supposed to be sailing among the Thousand Isles, is not held to be immediately cognizant of the islands by which he is surrounded, but only to know them through inference, mediately—there is nothing at all dangerous to our faith in a material world, in this limitation of the range of consciousness. For why do the various idealistic systems inevitably lead to scepticism? Because they furnish no basis whatever for our belief in the non-ego. Assuming that we immediately know only what is in the mind, they weary themselves in vain to infer from this the existence of anything without the mind. But Hamilton in affirming that we are conscious of material objects (though not of those which are distant,) destroys scepticism: for however narrow the sphere within which we communicate with an external world, the external world is, on his doctrine positively known to exist; and what we do immediately know of it, forms a foundation on which conclusions can safely be erected, regarding the existence of objective realities out of the reach of our immediate apprehension. "The doctrine of Natural Realism," Sir William writes, "requires no such untenable assumption for its basis," [as that distant realities are immediately perceived]. "It is sufficient to establish the simple fact, that we are competent, as consciousness assures us, immediately to apprehend, through sense the non-ego in certain limited relations; and it is of no consequence whatever either to our certainty of the reality of a material world, or to our ultimate knowledge of its properties, whether by this primary apprehension we lay hold, in the first instance, on a larger or a lesser portion of its contents."

But should it be denied that the existence of the non-ego is revealed in consciousness, what then? In fact, the whole body of Idealists maintain that consciousness gives no such testimony as Hamilton ascribes to it. How shall we decide this question? Philosophers, since the time of Kant, have commonly consented to regard universality and necessity as the sure criteria of first truths; and applying these, among other kindred tests, Sir William contends that mankind are universally and necessarily determined to believe that they immediately apprehend the non-ego. No man living—not even a philosopher—can help being fully persuaded, when he perceives, that he is apprehending immediately something finite and extended which is not self, but exists without self. Either, therefore, universality and necessity must be rejected from being criteria of first truths, or the existence of the non-ego must be allowed to be a datum of consciousness. Observe the difference between this use of the criterion

of necessity, and the reference which writers like Brown make to the irresistible belief that all men have of an external world. What Brown speaks of is a persuasion of the existence of an object which is not known, and possibly may be non-existent. On the other hand, the necessity which those who hold the non-ego to be revealed in consciousness, allege in support of their views, is just consciousness irresistibly asserting itself. Should it be said that, on this view, the application of the criterion of necessity to settle the question in dispute, involves a *petitio principii*—inasmuch as the conclusion sought to be established is proved by an appeal to a test, the affirmation of which is not substantially different from the affirmation of the conclusion; we answer that this objection would undoubtedly be valid, were the immediacy of our apprehension of an external world supposed to be *proved* (in the proper sense of the term) by the criterion mentioned. But this is not meant. All that is meant is, that the consciousness of an external world irresistibly asserts itself. A datum of consciousness cannot (strictly speaking) be proved by argument to be so; it must be immediately known as such; and if any one deny that a truth, which really forms one of the data of consciousness, is entitled to be regarded in that light, we must content ourselves with requesting him to purge his reflective eye with "euphrasy and rue," and to think again. If he do so, well. He will then recognise, without argument, what even now amidst his hallucination, he is knowing, and irresistibly feeling that he knows.—If not, his scepticism cannot be helped; reasoning will never drive it out of him; he must be permitted to enjoy it.

Neither Cosmothetic Idealists, nor those who, like Sir W. Hamilton, plead for an immediate apprehension of the external world, suppose that we know matter as absolutely existing; both parties agree that only its properties are known. From the earliest time, a two-fold distinction among the properties of matter had been recognized, corresponding more or less nearly (as stated by different writers) with Locke's distribution of the qualities of bodies into primary and secondary. Sir W. Hamilton adopts a new division; making three distinct classes of qualities, the primary, the secondary, and the secundo-primary; the last being so called, because they possess a double phasis, partaking in one aspect of the nature of the primaries, and in another of that of the secondaries. The grounds on which Sir William proceeds in this entirely original arrangement may be in a measure anticipated from what has been said; and a brief notice of his classification, will virtually involve a summary

of the leading points in his system, and must bring our exposition to a close.

It will be remembered that sensitive perception (taking the expression in its widest sense) apprehends three things—*first*, (in sensation) the affections of our animated organism—*secondly*, (in the perception of our organism as material) the relations of mutual outness which these bear to one another—and *thirdly*, (in the perception of extra-organic objects, not revealed to consciousness as material) resistance offered to the movement of our organism in space. We have here the basis of Sir W. Hamilton's division of the qualities of bodies. Sensation reveals to us the secondaries. The perception of the organism as material, discovers to us the primaries. And the perception of extraorganic resistance makes us acquainted with the secundo-primaries. To begin with the primaries. In being conscious of the relations of our organism to itself in space, we apprehend it as an object not indivisible and unextended like the ego, but such that affections exist in it, mutually external to one another: an object which is also finite, and which may hence be defined as "occupying space and contained in space." This is the definition of matter or body; and whatever properties can be evolved out of this definition, are primary qualities of matter. Thus, figure is a primary quality, because whatever occupies space and is contained in space, must possess figure. It is apparent that the primaries are only in an improper sense termed qualities (or suchnesses); for a body is not, by possessing them, constituted such a body. They do not discriminate one body from another, but belong to all bodies alike. Turn next to the secondaries. In being conscious of organic affections, we apprehend them as differing in kind or quality strictly so called. For example, one affection of the animated organism, apprehended by consciousness, gives the sensation of redness; another, the sensation of acidity—two sensations of a different kind or quality altogether. Now organic affections may be stimulated by causes either within or without the organism. To causes of the former description our attention is seldom powerfully called; but it is necessary on many accounts that the latter sort should be discriminated among themselves, and should receive distinctive names. Accordingly, when we have been led by experience to attribute a particular affection to the stimulating influence of some external body, we ascribe to that body a quality commonly denoted by the same name with the sensation produced in us. Such qualities, collected into a class, form the secondary quali-

ties of bodies. Thus we say that vinegar possesses the secondary quality of acidity, and a rose that of redness, because we suppose that the stimuli which originated the organic affections, in apprehending which we felt the sensations of acidity and of redness, proceeded from the vinegar and the rose respectively. We are entirely ignorant what the secondary qualities in bodies are; we only know the affections of which they are deemed to be the stimulating causes.—As the secondaries are revealed through sensation, and the primaries through the perception of our material organism, so the secundo-primaries are discovered (we said) by the resistance offered to the movement of our organism in space. We are not conscious of this resistance as proceeding from bodies; but after we have been led by induction to believe that it is exerted by bodies, we then reckon resistance to be a quality of bodies. But is it a primary or a secondary quality? It partakes in some sort of the nature of both. As a mode of resistance felt in us, it is allied to the secondaries. As a degree of resistance opposing our locomotive energy, it resembles the primaries, being like them objectively apprehended. It cannot therefore be placed under either of the two previous divisions; but must be constituted into a class by itself, viz: the class of secundo-primaries. Every particular species of resistance or pressure which a body is capable of exerting, against the movement of our organism, or against any other body, is a secundo-primary quality of the body in question.

G. P. Y.

SCIENTIFIC AND LITERARY NOTES.

GEOLOGY AND MINERALOGY.

EARTHQUAKES IN CALIFORNIA.

In a paper by Dr. Trask, of San Francisco, published in the May number of Silliman's Journal, it is stated that the number of earthquakes experienced in California in 1856, amounted to sixteen. The shocks, with one exception, appear to have been comparatively slight; and Dr. Trask (writing from San Francisco) observes moreover, that along the coast of Mexico and Central America, to the south of California, there seems to have been a much greater exemption from these phenomena than has been usual in former years. This appears to have been the fact also, throughout the Pacific, Oceanic, and most of the continental islands along the coast of China; while, on the contrary, to the north and northwest, beyond the fifty-fifth parallel, both volcanic and earthquake phenomena appear to have been of more than average intensity. Dr. Trask cites more especially, the neighbourhood of the Aleutian Archipelago, the north-east coast of Japan, the British and Russian possessions of North America on the Pacific, and the islands of the Sea

of Ochotsk. A submarine eruption in the Straits of Ourinack (lat. 54° 36' N., longitude 135' W.) is reported by Captain Newell, of the "Alice Frazer." A column of water was projected upwards to a height of several hundred feet, and immediately following this, immense masses of lava were thrown into the air whilst the sea for miles around, and for many days after, was covered with floating fragments of pumice. The principal earthquake experienced in San Francisco itself, during the year 1856, occurred on the 15th February, at about half-past five in the morning. Several buildings were injured; and the shock appears to have extended over an area of about one hundred and forty-three miles in length, by sixty-six in breadth.

ROCK-METAMORPHISM.

Professor T. Sterry Hunt, of the Geological Survey of Canada, has lately made known a very interesting illustration of metamorphic phenomena arising from the action of alkaline silicates on carbonate of magnesia or of iron, or earthy carbonates generally. His experiments show that when a mixture of silica and carbonate of magnesia is boiled with carbonate of soda, the silicate of soda, at first formed, is decomposed by the magnesian carbonate; and secondly, that the regenerated carbonate of soda is enabled to take up a new portion of silica: the result being a continued silification of the magnesia through the agency of the alkaline carbonate. Mr. Hunt finds that, if pulverized quartz be boiled for several hours with corbonate of soda and carbonate of magnesia, a large amount of magnesian silicate is formed; and that, if we suppose a solution of alkaline silicate (which will never be wanting among sediments in which feldspar exists) to be diffused through a mixture of siliceous matter and earthy carbonate, we shall have, with a temperature of 112° Faht. or perhaps with less, all the conditions necessary for the conversion of the sedimentary mass into pyroxenite, diallage, serpentine, talc, rhodonite, &c., all of which constitute beds in our metamorphic strata. If, also, aluminous matter be added to the above, the elements of chlorite, garnet and epidote will be present.

WATERS OF THE ST. LAWRENCE AND OTTAWA.

Professor Hunt has also communicated to the Philosophical Magazine for April, 1857, analyses of the waters of the St. Lawrence and Ottawa rivers, accompanied by some interesting observations, the concluding portion of which we give below. The subject will be found more fully discussed in the Report of the Geological Survey for 1854, now on the eve of publication.

1. *Water of the River St. Lawrence* (10,000 *parts.*)

A. Obtained.		*B. Calculated.*	
Carbonate of Lime........	0.8033 grm.	Carbonate of Lime	0.8033
Carbonate of Magnesia....	0.2537	Carbonate of Magnesia.......	0.2530
Chlorine	0.0242	Silica......................	0.3700
Sulphuric Acid	0.0687	Chloride of Potassium........	0.0220
Silica	0.3700	Chloride of Sodium..........	0.0226
Chloride of Sodium	0.1280	Sulphate of Soda............	0.1229
Chloride of Potassium	0.0220	Carbonate of Soda...........	0.0061
Residue, dried at 300°f ...	1.6780	Fe O and Mn O	traces.
Residue, ignited	1.5380	Al O and P O	traces.

2. *Water of the Ottawa River* (10,000 *parts.*)

A. Obtained.		*B. Calculated.*	
Carbonate of Lime	0.2480	Carbonate of Lime	0.2480
Carbonate of Magnesia	0.0696	Carbonate of Magnesia	0.0696
Chlorine	0.0076	Silica	0.2060
Sulphuric Acid	0.0161	Chloride of Potassium	0.0160
Silica	0.2060	Sulphate of Potassium	0.0122
Chloride of Sodium	0.0607	Sulphate of Soda	0.0188
Chloride of Potassium	0.0293	Carbonate of Soda	0.0410
Residue, dried at 306°f.	0.6975	$Al2O3$, $PO5$, $Fe O$, $Mn O$	traces.
Residue, ignited	0.5340		

"The comparison of the two river-waters whose analysis we have just given, shews the following differences:—The water of the Ottawa, containing little more than one-third as much solid matter as the St. Lawrence, is impregnated with a much larger proportion of organic matter derived from vegetable decomposition, and a larger amount of alkalies uncombined with chlorine or sulphuric acid. Of the alkalies in the state of chlorides, the potassium salt in the Ottawa constitutes 32 per cent., and in the St. Lawrence only 15 per cent.; while in the former the silica equals 34, and in the latter 23 per cent. of the ignited residue. The Ottawa drains a region of crystaline rocks, and the alkalies liberated by the decomposition of the feldspar of these rocks give their character to its waters; the extensive vegetable decomposition evidenced by the organic matters in solution, must also contribute a portion of potash; while the basins of the great lakes through which the St. Lawrence flows are excavated in palæozoic strata which abound in limestone, rich in salt and gypsum, and have given to the water of this river that predominance of soda, sulphuric acid and chlorine, which distinguishes it from the Ottawa. The presence of large amounts of silica in river-waters is a fact but recently established. Until the analysis by Deville of the rivers of France (1848), the silica in water had generally been wholly or in great part overlooked; and, as he suggests, had, from the mode of analysis been confounded with gypsum. The importance in an agricultural point of view of this large amount of dissolved silica, where river-waters are employed for the irrigation of land, is very great; and geologically, the fact is not less significant, as it marks a decomposition of the siliceous rocks by the action of waters holding in solution carbonic acid, and the organic acids arising from the decay of vegetable matter, which, dissolving the lime, alkalies, and magnesia, from the native silicates, liberate the silicic acid in a soluble form.* Silica is never wanting in natural waters, whether neutral or alkaline, although proportionably less abundant in neutral waters which contain large amounts of earthy ingredients. The alumina, whose presence is not less constant, although in much smaller quantity, appears equally to belong to the soluble constituents of the waters. The amount of dissolved silica annually carried to the sea by the rivers must be very great; yet sea-water, according to Forchhammer, does not contain any considerable quantity in solution; it doubtless goes to form the

* Although this may be true enough to a certain extent, yet, undoubtedly, a large portion of the silica present in the waters of rivers, more especially of such as flow through uncleared districts, is derived from the constant decomposition of the wood of fallen trees, of ferns and other vegetable matters. In the ashes of most ferns, the silica is over 70 per cent., and in those of equiseti, over 50; whilst it averages about 10 or 12 per cent. in the ashes of the bark, wood, and leaves (taken together) of our common pines. E. J. C.

shields of Infusoria, and may play an important part in the consolidation of the ocean sediments and the silification of organic remains."*

AZOIC ROCKS OF CANADA.

Professor Whitney in an article in the May number of Silliman's Journal, takes exception to Sir William Logan's subdivisions of our Azoic rocks. He contends that the so-called Huronian Formation belongs in part to the Potsdam sandstone, and in part to the underlying Laurentian group; and, further, that the latter should simply be called "Azoic," to the exclusion of the term "Laurentian"—this term having been already bestowed by Desor on the local, post-tertiary beds of Beauport, and other places, in the valley of the St. Lawrence and elsewhere. Without attempting, in the present place, to discuss the claims of the Huronian rocks to be considered a distinct formation, we may reasonably call in question the justness of that view, which, by collecting all of our unfossiliferous strata into a single group, would represent them as the products of a single epoch or period. Surely, if the Palæozoic age be looked upon as typical of at least four periods in the history of the Earth, a subdivision of some kind may be equally conceded to the formations of the great Azoic age: although from the absence of fossils, the subdivision of these formations may be a work of more difficult attainment. That such will some day be effected however, and to a greater extent than many geologists may at present be willing to allow, we are fully confident. With regard to the term Laurentian as applied to some of these Canadian rocks, we would observe, that, even if the same term were previously applied to the patches of post-tertiary strata alluded to above, its peculiar fitness for the gneissoid rocks of the Laurentian Range and connected country, would fully warrant its retention. On the other hand, we quite agree with Professor Whitney respecting the use of the term "Cambrian." If this term cannot be applied in accordance with the views of Sedgwick to the whole of the lower Silurians (a conclusion becoming more and more apparent every day,) let it be abandoned altogether. Its application to the Huronian formation, or to the Potsdam sandstone as proposed by Sir Charles Lyell, answers no object whatever, and is but little likely, moreover, to be generally adopted.

SUPPOSED EMERALDS FROM ALGIERS.

The pale green crystals from the Upper Valley of the Harrach in Algiers, announced as emeralds by M. Ville, have proved to be tourmalines, analogous to the somewhat rare variety met with at St. Gothard, and in Elba. They were first discovered in 1855, in a crystalline limestone associated with gypsum and diorite, about ten miles east of Blidah. (Bulletin de la Société Géologique de France; tome XIII, page 416.) Most tourmalines when treated with salt-of-phosphorus before the blow-pipe, effervesce and dissolve readily; but this pale green variety, curiously enough, behaves just like the emerald: exhibiting a scarcely perceptible effervescence, and dissolving very slowly.

CYSTIDEANS.

Mr. Billings, palæontologist to the Geological Survey of Canada, has discovered in the Chazy limestone near Montreal, a new Cystidean, more or less allied to *Cryptocrinus* by its three basal or pelvic plates, but differing from that genus by

* Some, although probably but a small portion, may be taken up by marine vegetation, as seven per cent. of silica appears to have been detected in the ashes of *fucus vesiculosus*. The ashes of most sea-weeds, however, contain no more than one or one-and-a-half per cent. of silica. E. J. C.

the possession, amongst other peculiarities, of more than two ranges of plates above the pelvic range. Mr. Billings proposes, we believe, for this new genus, the name of *Malocystites.*

The following list of the principal genera of Cystideæ at present known, with their leading characteristics, etc., may not perhaps be unacceptable to some of our readers.

Cystideæ :—principal genera :

1. *Echinosphærites,* Wallenberg (*Spheronites*) :—Cup of numerous plates with irregularly distributed pores. The principal species comprise: *E. Balticus, E. Aurantium, E. Pomum,* E. Punctatus,* and *E. Granulatus.*

2. *Caryocystites* (Von Buch):—Cup of five ranges or series of plates. Pelvic plates 2 + 2. Included by some palæontologists in *Echinosphærites.*

3. *Echino-encrinites,* Meyer (*Sycocystites,* V. Buch; *Gonocrinites, Eichwald,*) cup of 4 ranges of plates. Pelvic range: 3 + 1. Other ranges: 5, 5, 5. Pores bordering rhomboidal areas. Only two openings (?): perhaps one divided to serve both for anal and ovarian orifice.

4. *Glyptocystites* (Billings :)—Cup of 4 ranges. Pelvic range: 3 + 1. Other ranges: 5, 5. 5. Five (= 4 + 1,) attached arms. Three openings: the ovarian opening without valves (?), and distant from the mouth. Numerous pore-areas, or "pectinated rhombs." We have placed this genus here, because if not identical with *Echino-encrinites,* it is evidently closely allied to it. The numerous pore-areas constitute its great distinguishing feature. Where these pore-areas occur in other genera, more than three, or three pairs, are never present.

5. *Apiocystites* (E. Forbes.) Cup of 4 ranges. Pelvic range of 4 plates. Four attached arms in shallow grooves. One American species (*A. elegans*): Hall, Pal, New York, vol. II, page 241,) from the Niagara group. Perhaps identical with the *A. Pentremiorides* of the English survey.

6. *Prunocystites* (E Forbes.) 7. *Pseudocrinites* (E. Forbes.)

8. *Hemicosmites* (Von Buch):—Cup of 4 ranges. Pelvic plates 4. Plates of the other ranges: 6, 9, 8, (at least in the known species.) The three openings in the top range.

9. *Pleurocystites* (Billings :)—Large plates on only one side of the cup. On the other side a large opening, probably covered by an integument strengthened by numerous small plates. Pelvic range of six plates (= 2 + 2 + 2.) Second half range of three large plates. Third half-range of four plates. Top range (entire) of ten small plates carrying the two arms. Several species from the Trenton limestone of Ottawa.

10. *Callocystites* (Hall :)—Cup of 4 ranges. Pelvic range of 4 plates (=2 + 1 + 1.) Second range of 8 plates. Five attached arms. Stem of very thin joints, (at least in the known species:—V. Pal, New York, vol. 2, page 238). One species *C. Jewettii,* (Hall) from Niagara group.

11. *Malocystites* :—Mr. Billings' new genus alluded to above.

12. *Cryptocrinites,* or *Cryptocrinus* (Von Buch) :—Cup of three ranges. Three

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* E. Pomum is viewed by some authors as the type-form of a distinct genus (*Sphæronites,* an old name revived,) characterised by the presence of two pores, in place of several, on each plate.—E. J. C.

pelvic plates. Five plates in second, and six in top range. *C.* lævis is the more common species.

13. *Calliocrinites* (*Calliocrinus*, d'Orb)? Cup of two ranges. Pelvic range of 5 plates. Apparently a very doubtful genus.

Appendix:—Hemicystites, Hall, (including *Agelacrinites:* Pal, N. Y., vol. 2, page 245, and also page 355.) *Tetragonis*, Eichwald (including *Ischadites*, Murchison; and *Receptaculites*, Salter. (V. McCoy's Cambridge Museum Fossils, page 62.)

E. J. C.

CHEMISTRY.

NOTE ON THE OXALATE OF MANGANESE.

I have to correct a slight error in my note on the oxalate of manganese, published in a former number of this journal*. I have there supposed the formula of Graham's oxalate to be $Mn\,O, C^2O^3+5$ aq., whereas, adopting the bibasic character of the acid, it should be $2\,Mn\,O+C^4O^6+5$ aq.

Souchay and Lenssen have lately (Ann. Ch. u. Ph. April) examined the same salt, and confirm Graham's formula; in the single analysis mentioned in their paper, they found 37,55 p. c. of Mn O, the formula requiring 37,83. According to the formula $2\,Mn\,O+C^4O^6+6$ aq, the quantity of Mn O should be 36, 09, while my four determinations range from 36,39 to 36,79. The pink hydrate is very prone to lose water in a warm atmosphere, and if not analyzed quickly the amount of Mn O would of course come out too high.

Moreover, the quantity of water lost by the pink salt, at a temperature of 212° was in my experiments 8.75, the formula requiring 9.09, whereas if Graham's formula be adopted the loss should be only 4.78. The extrication of the water takes place easily and rapidly, and cannot therefore be due to a loss of water from the white hydrated salt, which, according to Liebig, loses nothing at 212°, and only after continuous heating, according to Souchay and Lenssen.

I am therefore inclined to retain the formula $2\,Mn\,O+C^4O^6+6$ aq.

H. C.

BORON.

By the action of aluminum on fused boracic acid, at a high temperature, Wöhler and Deville have obtained boron in the amorphous (already known), the graphitoid, and the crystallized state. The graphitoid boron is obtained by the action of an acid on the boride of aluminum, and appears in the form of spangles, often hexagonal, slightly reddish, and with the form and brilliancy of natural graphite and graphitoid silicon; it is perfectly opaque. The crystallized is obtained in small red or yellow crystals, the form of which cannot be determined, as they seem to be composed of a number of small crystals. These possess a brilliancy and refractive power only comparable to the diamond, and rival it in hardness. When heated it oxidizes only on the surface, not altered by nitre at a red heat, readily acted on by chlorine, and slowly by carbonate of soda at a red heat. It forms alloys with platinum and palladium.

When a filter on which amorphous boron has been dried is inflamed, the boron burns with great ease; the graphitoid variety resists combustion in this way.

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* Can. Jour. N. S. vol. ii. pp. 30—32.

MANGANESE.

Brunner prepares this metal by the action of sodium on the fluoride. Its specific gravity is 7.138–7.206, unchanged in the air, harder than steel, oxidizes on the surface when heated, like iron, is non-magnetic, dissolves readily in diluted sulphuric acid, and in nitric and hydrochloric acids. From its extreme hardness it may probably find useful applications in the arts.

CHROMIUM.

Fremy obtains this metal in crystals of great brilliancy by passing the vapour of sodium over the chloride. The crystals are very hard, and resist the action of the strongest acids.

SILVER IN SEA WATER.

It has long been known that sea water contains an appreciable quantity of silver, probably in the form of chloride, dissolved in the chloride of sodium. As such a solution is readily decomposed by metallic copper, Field was induced to examine whether the yellow metal employed in the sheathing of vessels contained more silver after long exposure to sea water than it did when first applied. One specimen from sheathing which had been used for seven years gave as much silver as would amount to upwards of one pound per ton. The original yellow metal could not be obtained for examination, but it undoubtedly could not have contained anything like this quantity. Sheathing, which had been exposed for three years was compared with some of the unused metal; the latter contained about one ounce of silver per ton, the former more than seven ounces.

Various other experiments were made, and in every case a similar difference observed, but in cases where the sheathing had only been exposed a short time, the differences were very slight.

MAGNESIUM.

Deville and Caron have prepared this metal in considerable quantities and examined its properties. They find that it resembles zinc in being volatile, and almost at the same temperature. It fuses at about the same temperature as zinc; at a higher point it inflames, and burns like zinc, producing a brilliant flame and white flakes. Specific gravity, 1.75.

PREPARATION OF METALS.

Deville recommends the use of lime crucibles in the preparation of chromium and manganese, as thereby the presence of silicium is avoided, which is almost always formed when earthen and porcelain crucibles are employed. Charcoal vessels are equally objectionable. Cobalt and Nickel, when prepared in this way, possess very different properties from those usually ascribed to them, cobalt being one of the most ductile and tenacious of metals. Manganese and chromium thus prepared are excessively hard; the latter, when pure, is less fusible than platinum, it dissolves readily in hydrochloric acid, giving a blue solution of Peligot's protochloride.

OXIDE OF SILICIUM.

Wöhler found that by heating silicium to a slight red heat in a current of dry hydrochloric acid gas, hydrogen is given off, and a new chloride of silicium formed. It is a very mobile fuming liquid, more volatile than the ordinary chloride. Water decomposes it into hydrochloric acid and the new oxide. The latter is white, slightly soluble in water, easily in alkalies, even in ammonia, evolving

hydrogen with effervescence, and being converted into silicic acid. When heated in the air it ignites and burns with a very white light.

FORMATION OF NITROUS ACID.

Tuttle has found that nitrous acid is formed when copper is oxidized in presence of ammonia ; the blue solution obtained by exposing strips of copper and ammonia to the air, contains nitrous acid. None is formed by exposing an ammoniacal solution of black oxide of copper, but a trace is produced by employing the colourless solution of the red oxide.

ÆTHYLAMINE.

According to Tuttle this is best prepared by heating a mixture of urea with five parts of sulphovinate of lime and excess of caustic lime. The vapours are passed into muriatic acid, the solution evaporated and treated with a mixture of alcohol and æther, to separate the sal ammoniac. The solution furnishes a deliquescent salt, from which the æthylamine can be obtained by the action of potassa.

ARTIFICIAL FORMATION OF GLYCERINE.

Wurtz has obtained glycerine in the following way: Berthelot's iodized propylene C^6H^5I is treated with excess of bromine, and a tribromide obtained $C^6H^5B^3$. This is mixed with acetate of silver, and excess of glacial acetic acid, and kept for several days at a temperature of 248°–257° F.; the liquid filtered off, and the bromide of silver washed with æther, the liquid distilled until the temperature rises to 284° F., the residue treated with lime and æther. The æthereal solution leaves a yellowish oil, which is triacetine, and can be resolved by saponification into acetic acid and glycerine. That the substance was really glycerine was proved by the action of iodide of phosphorus, which gave iodized propylene.

LEUCINE AND ALANINE.

Limpricht has found that by distillation leucine is resolved into carbonic acid and amylamine. Alanine yields æthylamine, and glycocine would, in all probability, give methylamine. H. C.

MISCELLANEOUS.

We are strongly tempted to find a place for the following graceful and humorous metrical tributes paid to one of the most distinguished scientific men of this continent, under our periodical heading of *Ethnology and Archæology*. Ethnological it will be seen the muse has grown, under the inspiration of her theme ; and though recognising the event she celebrates as one which looks forward to an antiquity yet to be attained : there is an Archæological treatment of the subject ample enough for all purposes, at least of the comic muse !

On the 28th of May last, the distinguished American savant, Louis Agassiz, attained his fiftieth birth day ; and on that pleasant anniversary an assembly of poets, men of science, and loving friends, of Boston and its neighbourhood, met together and celebrated a birth-day dinner, such as those who shared in the enjoyment of it will long keep in fresh remembrance. None who have met with the genial and highly gifted Agassiz, and so learned to appreciate how thoroughly the delightful elements of the companion and friend blend in him, with those of the acute and fearless investigator of science, will fail to appreciate the hearty sincerity and cordial warmth which must have united together the friends gath-

ered round the festive board on the late Anniversary of the Agassiz birth-day, "when Hope and Memory kissed," in welcoming him into his fiftieth year. No wonder that the poets found a ready inspiration alike for grave and graceful fancies; and for humorous, yet kindly irony, and playful badinage, such as sports with his favourite ethnic opinions, and humorously hints at the heresies of his scientific views in relation to his Adamic ancestry.

Various impromptu contributions proved the richness of the poetic fancy and humour which the happy occasion excited; while others, from the pens of some of America's most gifted poets, will survive as lasting memorials of the happy festive meeting. The following is the lively contribution of James Russell Lowell:—

A health to him who reached to-day
Life's height of water-shedding,
Where Hope and Memory kiss and say
Let's keep our golden wedding;
To him whose glow the heart could reach
Of glaciers that he studied,
Who learned whatever fish could teach,
Except to be cold-blooded!

To him, who, if our earth were lost,
And Nature wanted counsel,
Could make it over at less cost
From ridge-pole down to groun' sill:
Could çall the Dodo back to youth,
Could call Ornithorynchus,
Nay! were *we* gone, from just a tooth
Could good as new re-think us!

To him who every egg has scanned,
From roc to flea included,
Save those which savants find so grand
In nests where mares have brooded!
To him, who gives us each full leave
(His pedigree amended,)
To choose a private Adam and Eve
From whom to be descended!

But stay—for chance-come thoughts are best—
I meant the health to proffer
Of him, our friend there and our guest,
And yet not that I offer:—
No, rather drink this toast with me,
Worth any common dozen:
Here's Adam and Eve Agassiz,
To whom we owe our cousin!

Such is a good specimen of the gayer fancies which the happy anniversary has called forth. The following piece is graver, more earnest, and as we think, worthy of the occasion, no less than of the pen of America's gifted poet Longfellow:—

It was fifty years ago
In the pleasant month of May,
In the beautiful Pays de Vaud,
A child in its cradle lay.

And Nature, the old nurse took
The child upon her knee,
Saying: "Here is a story-book
Thy Father has written for thee.

"Come, wander with me," she said,
  "Into regions yet untrod;
And read what is still unread
  In the manuscripts of God."

And he wandered away and away,
  With Nature, the dear old nurse,
Who sang to him night and day
  The rhymes of the universe.

And whenever the way seemed long
  Or his heart began to fail,
She would sing a more wonderful song,
  Or tell a more marvellous tale.

So she keeps him still a child,
  And will not let him go,
Though at times his heart beats wild
  For the beautiful Pays de Vaud;

Though at times he hears in his dreams
  The Ranz des Vaches of old,
And the rush of mountain streams
  From glaciers clear and cold;

And the mother at home says "Hark!
  For his voice I listen and yearn;
It is growing late and dark,
  And my boy does not return!"

CANADIAN INSTITUTE.

ELEVENTH ORDINARY MEETING.—*7th March*, 1857.

Colonel Baron de Rottenburg, Vice-President, in the Chair.

The following Donations received since last Meeting were announced; and the thanks of the Institute voted to the Donors:

1. From B. Gibb, Esq., of Montreal, per A. H. Armour, Esq., :
"Two small mummy Crocodiles, from the mummy Pits of Upper Egypt."
"Some Egyptian Papyrus from Ancient Thebes."
"A small piece of mummy cloth."

2. From the Regents of New York State Library."
Documents relating to the Colonial History of the State of New York, Holland Documents, 1603, 1656. Vol. I.

4. From Messrs. Gould and Lincoln, per A. H. Armour, Esq., :
Annual of Scientific Discovery, 1857. 1 vol.

5. From Hon. J. M. Brodhead, Washington, per A. H. Armour, Esq., :
"Official Army Register, United States, for the year 1857." Pamphlet.
"Navy Register of the United States, for the year 1857." Pamphlet.

The following Gentlemen were elected Members:

John McNaughton, Esq., Lancaster, C. W.
John Morris, Esq., Toronto, C. W.
Dr. Samuel Stratford, New Zealand, Corresponding Member.

The following papers were then read;

1. By the Rev. Prof. Young, M.A.:

"On Sir David Brewster's supposed law of visible direction in monocular vision, and the corresponding law of visible direction in binocular vision."

2. By Professor Wilson, LL.D:

"Remarks on a specimen of Indian Corn having the male and female flower developed on the same stalk. The specimen was presented to the Institute.

3. By Col. Baron de Rottenburg:

"Report of the Committee appointed to consider a proposition from Lieutenant Ashe, R.N., for the establishment of an Astronomical Observatory at Quebec.

The Report was adopted, and the following draft of a memorial was approved of, and ordered to be transmitted to His Excellency the Governor General, and to the Legislative Council, and the Legislative Assembly, the Council being requested to take the requisite steps for securing the fitting presentation thereof.

The Memorial of the Canadian Institute Incorporated by Royal Charter,—

Humbly Sheweth,—That Your Memorialists have been informed that application has been made to Your Excellency by Lieutenant Ashe, Royal Navy, for an extension of the Astronomical Observatory at Quebec, whereby the same may be rendered more efficient and useful.

Your Memorialists most respectfully beg of Your Excellency to take this application into consideration, and in support of the same they desire humbly to represent to Your Excellency, that Astronomy, while deservedly ranking as the first of sciences, both on account of the certainty of its processes, the brilliancy of its results, and the wide field it offers for investigation, is at the same time that above all others which is most closely connected in its practical bearings with the interests of civilized life and the progress of commercial intercourse; that so fully has this truth been recognized that at the present day there does not exist a kingdom in Europe which has not established one or more National Observatories, while in the United States so strong an interest has been awakened on this point that such institutions are being founded in all parts of the country, of which the recently opened Observatory at Albany is a splendid and notable example.

Your Memorialists believe that even if the practical benefits that would result from the establishment of such an institution were not directly and immediately felt, Canada has now taken such rank among communities that it would not consist with her dignity to lag behind in the march of scientific research; but the requirements of her rapidly increasing commerce render this establishment almost a necessity.

Your Memorialists need only refer to the important duties which would devolve on the Observatory in connection with Navigation, such as the determination of true time, the regulation of Chronometers, the correction of Ship-compasses; and here also they might be permitted to recall the great services rendered by a similar institution at Washington, under the conduct of Lieutenant Maury, by his famous Charts and system of Navigation which are producing effects the value of which can hardly be over-rated.

Your Memorialists would also represent that Quebec is peculiarly and fortunately qualified for the site of an Observatory, both from its steady climate, the clearness of its atmosphere and its local advantages of position; and also from its being at once an inland town and a seaport.

Your Memorialists would not presume to dictate to Your Excellency the manner in which the object of this petition should be carried out, but they may be permitted to state their opinion that for a sum of Five Thousand Pounds and an annual endowment of One Thousand Two Hundred Pounds, a first-class Observatory could be efficiently and permanently constructed, equipped and maintained.

Your Memorialists, while urging with earnestness on your consideration this prayer, have all confidence in the wisdom and liberality of Your Excellency, and feel assured that should a National Canadian Astronomical Observatory be founded, it will be on a scale commensurate with the importance of the object and the character of the country.

And Your Memorialists as in duty bound will ever pray.

EDWARD J. CHAPMAN, *1st Vice-President.* DeROTTENBURG, *2nd Vice-President.* JOHN LANGTON, *3rd Vice-President.*

J. GEORGE HODGINS, *Secretary.*

TWELFTH ORDINARY MEETING.—14*th March*, 1857.

Professor E. J. CHAPMAN, Vice-President, in the Chair.

The following Donation for the Library was presented, and the thanks of the Institute voted to the Donor;

From T. Henning, Esq., :

"Villa and Cottage Architecture," by Calvert Vaux.

The following papers were then read:

1. By JAMES H. MORRIS, M.A.,:

"Notes of Travel in China."

2. By Col. BARON DE ROTTENBURG:

"Report of the Committee on Prof. Kingston's paper on the use of the Electric Telegraph in giving notice of storms.

The report of the Committee was adopted, and remitted to the Council to be carried into effect.

3. By Col. BARON DE ROTTENBURG:

"Extract of a letter from Mr. Chalmers of Barrie, F. R. Astronomical Society detailing some observations which he had made on the 26th February, on a supposed volcano in the moon.

THIRTEENTH ORDINARY MEETING.—21*st March*, 1857.

Professor E. J. CHAPMAN, Vice-President, in the Chair.

The following Gentleman was elected a Junior Member:

JAMES BEATTY, Esq.

The following Donations were announced, and the thanks of the Institute voted to the Donors:

1. From the Patent Office, Washington:
   "Report of the Commissioners of Patents for 1854: Mechanics. Vol. II.
2. From G. W. Allan, Esq.,:
   "Gould's Trochilidæ."
3. From John Gould, Esq.:
   "Fifty specimens of Birds."

A letter was read announcing the donation to the Institute by Jesse Ketchum, Esq, of two acres of land on Yonge Street, for the erection of an Astronomical Observatory, on condition that the Institute shall take effectual steps for establishing the same within two years from this date.

The letter was referred to the Committee on the Quebec Observatory.

The following papers were then read:

1. By J. H. Morris, M.A.,:
   "Notes of Travel in China." Part II.
2. By Professor Wilson, LL.D.,:
   "On certain homogeneous characteristics ascribed to the aboriginal tribes of this continent."
3. By John McNaughton, Esq.,:
   "Some remarks on the relations of Canada to the adjacent territories."

FOURTEENTH ORDINARY MEETING.—28*th March*, 1857.

John Langton, M.A.. Vice-President in the Chair.

The following Gentlemen were elected Members:

George A. Pyper, Esq., Toronto.

William McCabe, Esq., Whitby, C.W.

The following Donation to the Library was announced, and the thanks of the Institute voted to the Donor:

From the Author:
"Surnames," by B. Homer Dixon, Esq., Boston. Privately printed.

The following papers were then read:

1. By the Rev. A. Constable Geekie:
   "On Canadian English."
2. By A. Brunel, Esq., C.E.:
   "A proposition, in relation to the Desjardin-Bridge Railway accident, to refer the subject of the strength of timber used in railway bridges, to gentlemen connected with the Institute, whose tastes or pursuits are connected with such an inquiry."
   An interesting discussion arose from this communication, and while it was not deemed expedient to make any special reference of the subject, a wish was expressed that the matter should engage the attention of some members of the Institute, whose practical knowledge qualified them for such an inquiry, and that the results be communicated to the Institute, and published in the Journal.

MEAN METEOROLOGICAL RESULTS AT TORONTO FOR THE YEAR 1856. *Read before the Canadian Institute* 21*st February.* 1857.

BY PROFESSOR KINGSTON, M. A., DIRECTOR OF THE PROVINCIAL MAGNETIC OBSERVATORY, TORONTO.

The year 1856, was a year of extremes. It was the coldest, the most windy, and the least rainy year of any known in the history of the Observatory, and, omitting two exceptions, one of each kind, it affords instances also of the highest and the lowest temperatures that have been ever recorded.

Ushered in by a day cold, keen, and of unusual brilliancy, the year commenced with the coldest and most windy January on record. The month was rainless, and showed no trace of the ordinary January thaw. February and March were more windy respectively, than any previous February and March; and with the exception of February and March, 1843, and February, 1855, they were colder than the corresponding months of all past years. These two months also, like January, were without rain, and it was not till the 2nd of April that the first rain of the year began to fall, after an interval, quite unprecedented, of 109 days.

The Spring was backward; the ice did not wholly disappear from the Bay till the 19th of April, and snow, though in a very slight quantity, fell as late as the 30th of May.

July was the warmest July but one yet known. In October, a fog, remarkable for density, duration and extent, prevailed from the 19th to the 22nd inclusive, and was said to have extended from Chicago as far as Quebec. In November the snow exceeded that of any previous November. December was marked by the coldest day and lowest temperature that ever occurred in the month of December, and by the most windy day recorded in any month whatever, in this or past years.

The mean temperature of 1856 was 42°.16, which is 1°.99 below the average of 17 years, and the lowest annual mean on record; the nearest approach to it having been 42°.35 in 1843.

As usual, July was the warmest month in the year; its mean temperature was 69°.9. July, besides being absolutely, was also relatively the warmest month in the year, estimated, that is, by the excess of its mean temperature above the standard temperature for the month, whether the standard chosen be that belonging to the parallel passing through Toronto or to Toronto itself. When considered further, with reference to past years, the mean temperature of July, 1856, was never exceeded by any monthly mean excepting that of July, 1854, which was 72°.5.

The coldest month absolutely was February, with a mean temperature of 15°.69; the coldest month relatively to the standard of Toronto, was January, with a mean temperature 7°.81 below the average. The warmest day was July 17, when the mean temperature was 81°.77, and the coldest day was Feb. 13 with a mean temperature—6°.88.

The maximum temperature of the year, 96°.6, occurred on July 17, and, with the exception of that of 24th August, 1854, when it reached 98°.1, was higher than any temperature before known at the Observatory. The minimum of the year—18°.7, on Feb. 12, was an example of cold never exceeded but in February of the preceding year.

The range of temperature for the year, derived from these two extremes, was 115°.3, one never exceeded but by that of 1855, which amounted to 118°.2.

The deviations in *defect* from the normals and exceeding 20° were numerous; but no example occurred of a deviation to that extent in *excess*.

BAROMETER.—The highest reading of the barometer was 30.480 inches, at 10.30 A. M. of Dec. 18th, and the lowest 28,459 inches, at 11.40 A. M. of Dec. 14, thus giving a range (the range also of the whole year) of 2.021 inches in less than 95 hours. The minimum, 28,459, was identical with that of 1855, which occurred on the 9th of Dec., and which also was followed by a considerable rise.

The mean humidity of the year, .75 of saturation, was rather less than usual, and the distribution of humidity among the different months more than ordinarily equable. Complete saturation occurred only four times—Jan. 9, Oct. 18, and the 11th and 14th of December. The greatest dryness was .30, which occurred at 4 P. M., of Aug. 11th.

It will be seen from the table, that the extent of sky clouded was on the average .75 of the whole sky, and rather less than in the two preceding years. Of the different months, November was the most cloudy, and July most free from clouds.

The resultant direction of the wind was N 71° W, and the resultant velocity 3.03 miles, or in other words, the actual displacement of air was that which would have been produced by a wind blowing throughout the year from N 71° W, with a constant velocity of 3.03 miles per hour. The mean velocity of the wind, without regard to direction, was 8.31 miles per hour, a velocity exceeding the average of nine years by 2.19 miles.

The whole depth of rain that fell during the year, 21.505 inches, was less by upwards of ten inches than that of 1855, and more than nine inches below the average of the last 16 years. The depth of snow was 65.5 inches, which exceeds the average by 3.6 inches, but falls short by more than 13 inches of the snow of the preceding year. The rain occupied 359.7 hours, and the snow 310.8 hours in its fall, giving 670.5 hours, or nearly 28 days, as the total duration of the fall of rain and snow.

Frost occurred in every month but in June, July and August. The latest frost in Spring was on 31st May, and the earlist frost in Autumn on Sept 21. The last snow in Spring was on the 30th of May, and the first snow in Autumn on 30th Oct. The Bay of Toronto was frozen over on Dec. 8.

Twenty-five thunder storms only occurred during the year. The most remarkable example was that of the 4th of June, which was accompanied for a short time by a violent fall of hail with stones in many cases more than half an inch in diameter. The storm lasted, with only occasional intermission, from 10 A. M. to 10 P. M., with the wind mostly from the East.

Of the 212 nights when the state of the sky was favorable for observing auroras, there were 35 nights only when auroras were seen, and these all belonged to the lowest class, unless that of Oct. 4 be excepted, when the phenomenon was accompanied by considerable magnetic disturbance.

The usual August season for the appearance of falling stars, passed by without any remarkable display, either as regards number or apparent magnitude. In November the sky was not favourable for the exhibition of these meteors.

The following table exhibits the general Meteorological Register, for the year 1856, deduced from the observations taken at the Provincial Observatory, Toronto:

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year 1856.	Year 1855.	Year 1854.	Year 1853.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Mean Temperature	16.02	15.69	23.06	42.27	50.52	62.11	69.90	63.59	57.15	45.34	37.39	22.88	42.16	43.98	45.21	44.78
Difference from average (17 years)	−7.81	−6.90	−6.88	+0.88	−0.93	+0.70	+2.92	−2.47	−0.89	+0.15	+0.59	−3.14	−1.99	−0.29	+0.87	+0.44
Thermic Anomaly (Lat. 43° 40′ N)	−16.78	−19.01	−17.01	−7.93	−7.58	−2.49	+1.20	−4.91	−4.35	−8.46	−5.81	−13.12	−8.84	−7.02	−5.79	−6.22
Highest Temperature	34.4	37.8	41.4	72.2	82.2	89.2	96.6	82.7	78.4	71.4	56.4	42.2	96.6	92.8	99.2	94.9
Lowest temperature	−12.1	−18.7	−14.0	14.2	31.2	42.0	49.5	41.5	35.0	23.0	18.8	−9.1	−18.7	−25.4	−10.8	−9.7
Monthly Range	46.5	56.5	55.4	58.0	51.0	47.2	47.1	41.2	43.4	48.4	37.6	51.3	48.63	50.63	50.90	48.47
Mean Maximum Temperature	22.68	24.2	30.47	50.47	59.56	71.59	80.30	73.74	66.63	54.04	43.03	28.74	……	……	……	……
Mean Minimum Temperature	6.02	3.57	12.87	33.39	40.63	52.39	59.0	52.95	45.60	35.22	28.74	15.55	……	……	……	……
Mean daily Range	16.63	20.63	17.60	17.08	18.93	19.20	21.3	20.79	21.03	18.82	14.27	13.19	18.29	18.19	19.77	16.89
Greatest daily Range	34.6	28.7	32.4	29.4	44.2	28.8	28.7	31.5	29.5	28.5	32.4	25.5	44.2	39.4	44.5	40.9
Mean Height of Barometer	29.6696	29.4883	29.5592	29.5790	29.5822	29.5484	29.5912	29.5208	29.6001	29.7069	29.6421	29.7113	29.5999	29.6249	29.6077	29.6299
Difference from average (12 years.)	+.0398	−.1242	−.0722	−.0281	−.0013	−.0334	−.0061	−.1153	−.0540	+.0371	+.0233	+.0650	−0.0200	+0.0050	−0.0122	+0.0100
Highest Barometer	30.280	30.086	30.032	30.099	29.969	29.798	29.844	29.797	30.013	30.200	30.048	30.480	30.480	30.552	30.245	30.315
Lowest Barometer	29.186	28.778	28.828	29.081	29.125	29.207	29.241	29.174	29.149	29.217	28.902	28.459	28.459	28.459	28.685	28.653
Monthly Range	1.094	1.308	1.254	1.018	0.844	0.591	0.603	0.623	0.864	0.983	1.146	2.021	1.029	1.032	1.074	0.986
Mean Humidity	.78	.76	.74	.75	.71	.79	.69	.73	.75	.75	.78	.82	.75	.77	.79	.79
Mean Elasticity of Aqueous Vapour	0.080	0.080	0.099	0.203	0.253	0.432	0.489	0.419	0.351	0.231	0.179	0.110	0.244	0.263	0.279	0.271
Mean of Cloudiness	.66	.55	.52	.60	.59	.47	.30	.48	.49	.47	.81	.76	.57	.60	.59	.57
Resultant Direction of the Wind	75° W	81° W	N 71° W	N 29° E	N 4° E	S 21° W	N 79° W	N 50° W	S 79° W	N 76° W	S 85° W	S 87° W	N 71° W	N 62° W	N 43° W	N 38° W
" Velocity (miles per hour.)	5.24	7.70	7.68	1.64	3.99	0.90	1.57	2.97	1.98	2.15	2.95	4.62	3.03	2.51	1.37	1.17
Mean " " "	10.69	10.71	11.30	6.05	9.81	5.30	5.84	7.03	6.53	6.07	8.75	11.56	8.31	8.18	6.02	5.08
Difference from average (9 years)	+3.44	+3.34	+3.89	−0.66	+3.90	+0.89	+1.31	+2.18	1.24	+0.65	+2.23	+3.83	+2.19	+2.33	+0.53	−0.33
Total amount of Rain (inches)	0.000	0.000	Inapp.	2.780	4.580	3.200	1.120	1.680	4.105	0.875	1.373	1.790	21.505	31.650	27.765	23.550
Difference from average (16 years.)	−1.595	−1.62	−1.512	+0.190	+1.511	−0.149	−2.447	−0.974	0.331	−1.925	−1.548	+0.251	−9.329	+0.236	−3.576	−8.076
Number of days Rain	0	0	0	13	14	13	8	12	13	10	10	6	99	103	114	109
Total amount of snow (inches)	13.6	9.7	16.2	0.1	Inapp.	……	……	……	……	0.1	9.5	16.3	65.5	99.0	49.5	53.2
Difference from average (14 years)	0.2	−8.0	+5.9	−1.8	−0.1	……	……	……	……	−1.0	+6.5	+1.9	+3.6	+37.4	−8.9	−6.1
Number of days snow	14	8	12	3	1	……		……	……		9	20	69	64	52	52
Number of fair days	17	21	19	14	16	17	23	19	17	19	11	[illegible]	198	198	193	204
Number of Auroras observed	1	5	7	4	0	1	4	[illegible]	3	3	1	1	35	46	52	57
Possible to see Aurora (No. of Nights)	12	20	20	18	16	18	26	2[illegible]	20	19	16	11	212	204	203	233
Number of Thunderstorms observed	0	0	0	2	2	9	4	[illegible]	4	1	0	0	25	38	58	34

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—APRIL, 1857.

Latitude—43 *deg.* 39.4 *min. North. Longitude*—79 *deg.* 21 *min. West. Elevation above Lake Ontario,* 108 *feet.*

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Mean Temp. +or— of the Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN	6 A.M	2 P.M	10PM	ME'N		6 A.M	2 P.M	10 P.M	M'N	6 A.M	2 P.M	10 P.M	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M	2 P.M	10PM	Result.	ME'N		
					°	°	°	°	°												°							
1	29.268	29.448	29.717	29.4907	39.3	23.2	15.8	26.68	— 9.55	.190	.097	.082	.118	.80	.76	.87	.77	Calm.	N W b N	N N W	N 26 W	0.0	26.0	29.2	22.36	23.03	Inap	0.3
2	.822	.927	30.006	.9333	10.0	27.4	22.7	20.35	—16.28	.061	.075	.082	.073	.83	.49	.64	.65	N N W	W N W	N W	N 32 W	16.2	13.4	5.5	9.11	9.25	...	...
3	.968	.794	29.636	.7840	19.4	35.3	27.4	28.23	— 8.78	.082	.128	.131	.117	.75	.62	.86	.75	N	E S E	Calm.	S 51 E	2.5	14.5	0.0	3.12	5.61	...	...
4	.588	.564	.528	.5477	35.9	51.9	39.5	43.40	+ 6 07	.176	.236	.212	.217	.83	.62	.88	.78	W b S	S	N N E	S 48 W	1.6	7.0	7.0	1.89	5.72	0.020	...
5	.347	.240	—	—	40.7	44.3	—	—	—	.240	.259	—	—	.95	.90	—	—	E	S b W	N N W	S 77 W	3.7	7.0	18.5	3.65	9.44	0.390	2.0
6	.116	.157	.246	.1792	31.0	31.4	19.4	26.90	—11.13	.164	.108	.088	.121	.95	.62	.81	.81	W b N	S W b W	W	S 72 W	11.2	22.4	8.0	12.77	13.74	...	2.7
7	.411	.668	.764	.6322	19.3	31.7	30.6	27.65	—10.77	.076	.113	.149	.113	.69	.63	.88	.73	W b S	S W b W	S S W	S 48 W	20.1	14.5	6.0	9.84	13.87	...	0.3
8	.606	.524	674	.6083	31.5	40.2	36.4	35.60	— 3.12	.147	.197	.186	.178	.82	.80	.87	.86	E	S S E	W	S 21 W	10.6	3.5	2.1	0.94	6.39	Inap	1.9
9	.716	.720	.766	.7352	32.4	40.0	31.4	34.82	— 4.22	.157	.168	.153	.159	.86	.69	.87	.79	N W b W	S b E	N E	S 85 E	2.0	7.5	1.5	0.84	3.88	...	...
10	.719	.647	—	—	30.7	41.8	—	—	—	.140	.159	—	—	.81	.61	—	—	N b E	S b E	N	N 36 E	6.0	10.0	7.5	3.04	7.27	...	...
11	.491	.421	.483	.4653	32.4	41.5	34.2	36.00	— 3.73	.144	.189	.172	.168	.79	.73	.88	.79	N b W	S S W	N W	N 43 W	11.6	7.0	10.0	5.26	7.87	...	...
12	529	.530	—	—	32.1	41.5	—	—	—	.146	.221	—	—	.80	.85	—	—	N N W	S	W N W	S 48 W	1.9	11.7	3.0	3.87	5.27	...	...
13	.654	.630	.526	.5942	28.1	42.3	37.1	36.43	— 4.00	.138	.172	.125	.156	.88	.64	.57	.73	N	E	N b E	N 65 E	1 0	8.4	1.2	4.20	5.55	...	...
14	.388	.233	.132	.2330	35.1	44.5	37.5	38.55	— 2.18	.157	.213	.187	.189	.78	.73	.84	.82	N E b N	S S W	W b S	S 67 W	9.2	7.4	21.5	6.02	11.93	Inap	...
15	28.959	28.938	.077	28.9963	35.0	36.1	32.1	34.47	— 6.58	.166	.159	.166	.161	.82	.75	.92	.82	S W b S	W S W	W b N	S 62 W	11.5	23.0	19.0	14.80	15.48	...	0.5
16	29.155	29.232	.391	29.2720	30.3	37.5	32.8	33.55	— 7.93	.151	.143	.173	.158	.89	.64	.93	.83	W S W	S W b S	S W b W	S 54 W	7.5	14.8	4.0	8.75	10.11	...	0.2
17	.524	.600	.643	.5928	27.4	39.3	31.5	33.17	— 8.58	.131	.133	.113	.122	.86	.56	.64	.65	W N W	S S W	N	S 55 W	8.8	16.4	6.0	6.03	10.53	...	...
18	.590	.512	.485	.5223	27.9	37.3	40.0	35.83	— 6.23	.118	.115	.221	.152	.77	.52	.91	.72	N	E N E	E b N	N 73 E	6.8	7.0	8.0	7.36	8.20	Inap	...
19	.469	.432	—	—	36.1	35.7	—	—	—	.203	.201	—	—	.96	.96	—	—	S	S S E	N W	N 53 W	2.6	14.0	8.5	2.36	7.51	0.565	1.8
20	.549	.498	.448	.4892	28.3	40.9	36.2	35.17	— 7.62	.138	.169	.132	.147	.89	.66	.63	.73	W N W	N N W	N W	N 32 W	15.8	24.0	19.2	20.36	20.52	...	1.5
21	.332	.321	.424	.3620	34.2	46.2	35.0	38.45	— 4.65	.186	.221	.187	.194	.95	.72	.92	.84	N N W	N b W	N b W	N 9 W	17.4	8.2	1.0	6.67	8.11	0.095	0.2
22	.449	.441	.483	.4617	37.4	50.0	38.2	42.58	— 0.78	.159	.177	.150	.163	.72	.49	.65	.61	N b W	N b W	N N W	N 21 W	11.1	13.5	9.5	12.64	12.83	...	...
23	.513	.518	.574	.5372	33.7	46.5	36.4	39.15	— 4.55	.140	.165	.192	.165	.72	.53	.90	.70	N N W	N W b N	N N W	N 30 W	12.3	13.5	15.4	12.38	12.64	...	...
24	.591	.557	.636	.5878	34.3	48.0	37.3	40.10	— 3.90	.158	.184	.150	.171	.78	.56	.68	.69	N W	S b E	N N W	N 76 W	8.0	8.2	3.3	3.63	6.57	...	...
25	.618	.586	.650	.6145	31.7	49.0	35 7	39.55	— 4.85	.144	.193	.131	.159	.80	.57	.62	.66	N W	W N W	N W	N 52 W	6.0	14.6	6.4	9.30	9.85	...	...
26	.627	.516	—	—	32.4	44.2	—	—	—	.131	.180	—	—	.72	.63	—	—	W b S	S b E	E b N	S 86 E	1.8	4.8	18.0	5.07	7.83	0.670	1.5
27	.120	.102	.398	.2208	37.9	42.9	37.1	39.27	— 5.75	.214	.184	.191	.196	.95	.67	.87	.83	S W b W	S W b W	N W b W	S 86 W	8.4	21.4	24.8	15.84	19.09	0 015	...
28	.579	.637	.770	.6663	34.3	46.6	31.4	37.93	— 7 47	.174	.199	.134	.166	.89	.63	.76	.73	W	N W b W	Calm.	N 62 W	4.0	19.2	0.0	11.77	12.14	...	...
29	.826	.824	.848	.8403	31.4	46.8	37.5	39.50	— 6.23	.153	.195	.127	.172	.87	.61	.57	.69	W b S	S b E	N	N 85 W	1.0	5.4	10.5	0.87	6.49	...	...
30	.938	.953	.813	.8840	34.2	44.9	38.6	40.55	— 5.50	.145	.175	.164	.158	.74	.59	.70	.64	N b E	E b S	E N E	N 80 E	5.2	10.4	10.5	10.28	10.60	...	...
M	29.5108	29.5122	29.5647	29.5300	30.90	40.86	33.27	35.36	— 5.63	.147	.164	.152	.156	.82	.63	.79	.74	....	....	....	....	7.53	12.62	9.50	......	10.24	1.755	12.9

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR APRIL, 1857.

Highest Barometer	30.006 at 10 p. m. on 2nd	Monthly range= 1·108 inches.
Lowest Barometer	28.898 at 9.20 a. m. on 15th	
Self-registering Ther. Maximum temperature	52°0 on p. m. of 25th	Monthly range= 46°1
Minimum temperature	15.9 on a. m. of 2nd	
Mean maximum temperature	43°36	Mean daily range = 16°12
Mean minimum temperature	27°24	
Greatest daily range	32°5 from a. m. of 1st to a. m. of 2nd.	
Least daily range	9.0 from p. m. of 15th to a. m. of 16th.	
Warmest day . . 4th ... Mean Temperature	43°40	Difference=23°05.
Coldest day . . . 2nd ... Mean Temperature	20.35	
Maximum Radiation. Solar	69°0 on p. m. of 29th	Monthly range= 73°0
Terrestrial	—4.0 on a. m. of 2nd	

Aurora observed on 1 night, viz.: 22nd at 10 p.m; possible to see Aurora on 17 nights; impossible to see Aurora on 13 nights.

Snowing on 11 days; depth, 12.9 inches; duration of fall, 41.9 hours.

Raining on 10 days; depth, 1.755 inches; duration of fall, 39.6 hours.

Mean of cloudiness=0.54; most cloudy hour observed, 2 p. m., mean=0.67: least cloudy hour observed, 10 p. m.; mean=0.42.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
3080.40	1591.83	1087.08	3676.85

Resultant direction of the wind, N 60° W; Resultant Velocity, 4.15 miles per hour.

Mean velocity of the wind 10.24 miles per hour.
Maximum velocity . . . 33.6 miles per hour, from 9 to 10 p. m. of 27th.

Most windy day . . . . . . 1st—Mean velocity, 23.03 miles per hour.
Least windy day . . . . . . 9th—Mean velocity, 3.88 do

Most windy hour noon to 1 p. m.—Mean velocity, 13·30 do } Difference
Least windy hour 4 to 5 a. m.—Mean velocity, 7.30 do } 6.00 miles.

Solar Halos on 3rd from 2 to 3 p. m. (perfect) 4th 7 to 8 a. m. 10th Halo & Parhelia 6.30 to 7.30 a. m. and on 23rd, 10 a. m. to noon.
Lunar Halos on 7th from 8 to 10 a. m. (large and perfect) 8th, 11 p. m. 9th at midnight (perfect).
1st—Very stormy day, with occasional Rain and Snow.
13th—Foggy at 8 a. m. on 14th 6 and 8 a. m.
14th—Distant Thunder at 3.50 p. m.
28th—Thin Ice on the pools at 5.30 a. m.
29th and 30th—Hoar frost at 6 a. m.

Temperature—This month was the coldest April that has occurred during the last 18 years being 5°7 below the average. It shews also the lowest maximum temperature, and with one exception the lowest minimum temperature during the same period.

Rain and Snow—The quantity of rain was small, being 0.783 inches below the average; but it was more than compensated by the great depth of snow that fell which was 10.29 inches above the average or about five times the usual depth. The total moisture was thus °246 inches above the mean.

Wind—This was the most windy April on the records of the observatory, the velocity of the wind being 3.17 miles above the average of ten years.

The Resultant Direction and Velocity from 1848 to 1857 inclusive for the month of April were N. 19° W., 1.93 miles per hour.

COMPARATIVE TABLE FOR APRIL.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	No. of days.	Inches.	No. of days.	Inches.	Resultant Direction.	Resultant Velocity.	Mean Velocity
1840	42.4	+ 1.3	65.9	25.3	40.6	14	3.420	2	...	—	—	—
1841	39.2	— 1.9	62.9	22.1	40.8	3	1.370	3	...	—	—	0.51 lbs
1842	43.1	+ 2.0	89.5	21.6	67.9	8	3.740	2	...	—	—	0.57 "
1843	40.9	— 0.2	70.0	15.1	54.9	7	3.185	3	0.1	—	—	0.46 "
1844	47.5	+ 6.4	74.5	17.2	57.3	10	1.515	1	Inapp	—	—	0.24 "
1845	42.1	+ 1.0	66 0	14.8	51.2	11	3.290	4	1.5	—	—	1.00 "
1846	44.0	+ 2.9	79.4	24.4	55.0	10	1.300	2	1.3	—	—	0.55 "
1847	39.2	— 1.9	65.6	8.4	57.2	8	2.870	2	4.0	—	—	0.59 "
1848	41.3	+ 0.2	65.4	26.5	38.9	5	1.455	1	0.5	N 77 W	1.46	4.89 mls
1849	39.0	— 2.1	70.9	23.2	47.7	10	2.655	2	1.7	N 43 W	3.14	7.50 "
1850	37.9	— 3.2	63.2	18.2	45.0	7	4.720	2	1.1	N 39 W	1.12	7.64 "
1851	41.3	+ 0.2	59.2	25.8	33.4	11	2.295	3	1.2	N 14 E	2.52	8.07 "
1852	38.2	— 2.9	53.8	19.8	34.0	6	1.990	4	9.4	N 23 E	2.44	6.68 "
1853	41.9	+ 0.8	65.7	27.0	38.7	10	2.625	1	1.0	N 12 W	1.90	5.20 "
1854	41.0	— 0.1	65.1	22.3	42.8	12	2.685	4	2.7	N 53 E	2.44	6.82 "
1855	42.4	+ 1.3	63.8	12.2	51.6	8	2.030	3	1.6	N 36 W	3.99	7.57 "
1856	42.3	+ 1.2	69.8	15.1	54.7	13	2.780	3	0.1	N 29 E	1.64	6.05 "
1857	35.4	— 5.7	51.9	10.0	41.9	10	1.755	11	12.9	N 60 W	4.15	10.24 "
Mean	41.06	...	66.81	19.39	47.42	9.1	2.538	2.9	2.61	—	—	7.07

MONTHLY METEOROLOGICAL REGISTER AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—MAY, 1857.

Latitude—43 deg. 39.4 min. North. Longitude—79 deg. 21 min. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Mean Temp. + or — of the Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Result't. Direc-tion.	Direction of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M	2 P.M	10 P.M	ME'N		6 A.M	2 P.M	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M	10 P.M.		6 A.M.	2 P.M.	10 P.M.	Re-sult'.	ME'N		
1	29.679	29.546	29.492	29.5662	°41.8	°44.7	°42.9	°43.42	—°3.00	.185	.252	.239	.231	.71	.86	.88	.83	E N E	E b S	S S E	S 78° E	8.3	3.6	5.2	5.11	5.50	0.345	...
2	.413	.432	.586	.4887	43.6	42.0	38.9	41.23	— 5.48	265	224	203	226	94	85	87	88	E N E	N W	W N W	N 38 W	1.8	18.5	7.6	8.13	8.96	0.420	...
3	.694	.683	—	—	37.8	47.3	—	—	—	208	241	—	—	92	75	—	—	Calm.	S b E	E N E	S 54 E	0.0	12.0	3.0	2.49	5.39	...	...
4	.653	.518	.306	.4663	38.2	41.5	43.6	41.62	— 5.80	180	221	265	228	79	85	94	87	E N E	N E b E	N E	N 53 E	12.2	10.2	21.5	12.96	13.27	1.375	...
5	.225	.270	.351	.2850	40.9	49.2	41.5	43.75	— 3.98	244	298	246	265	97	86	95	94	Calm	E S E	Calm.	N 46 W	0.0	2.5	0.0	0.11	4.61	0.245	...
6	.415	.516	.600	.5202	38.2	42.7	41.3	40.82	— 7.22	202	228	190	210	88	84	73	83	W N W	S W b S	Calm.	N 75 W	11.2	3.2	0.0	4.53	5.16	Inap	...
7	.656	.656	.741	.6877	36.8	50.5	41.1	43.52	— 4.90	189	293	186	227	87	81	73	81	W b N	S E	W S W	S 9 E	2.2	7.5	0.4	1.30	3.44	0.020	...
8	.819	.823	.694	.7749	38.6	53.8	46.2	46.48	— 2.30	160	287	220	216	69	71	71	69	N b W	E b S	E N E	N 85 E	3.6	5.2	4.8	4.35	5.42	...	...
9	.600	.470	.343	.4462	42.2	62.4	61.3	55.73	+ 6.57	222	299	489	329	85	54	92	75	N E	S W	W b N	S 46 W	0.4	12.0	13.0	8.06	9.97	0.315	...
10	.282	.494	—	—	51.9	42.3	—	—	—	234	161	—	—	61	60	—	—	W	W b N	N W b N	N 58 W	24.0	29.8	18.5	20.65	22.39	...	Inap
11	.824	.816	.813	.8205	27.9	36.0	32.4	31.95	—17.95	119	140	153	134	77	67	83	74	N N W	S S W	N W	N 49 E	14.0	9.8	6.5	3.45	8.65	...	...
12	.862	.839	.835	.8485	32.4	46.3	36.4	39.72	—10.45	138	183	158	163	75	59	74	67	N N W	S S E	N N W	S 28 E	7.6	6.9	1.5	1.22	4.73	...	...
13	.861	.773	.646	.7493	36.8	50.9	44.3	45.40	— 5.17	154	154	230	175	73	42	80	69	N W b N	S S W	N	N 70 E	1.2	5.8	6.9	1.34	6.36	...	...
14	.460	.321	.328	.3530	45.4	46.9	46.2	46.25	— 4.63	212	213	243	220	71	67	73	71	N E	E b N	E b N	N 68 E	17.0	21.0	10.9	16.98	17.25	0.250	...
15	.232	.268	.383	.3035	42.5	48.0	46.3	45.57	— 5.72	260	278	237	254	97	84	76	84	E N E	N b E	W b S	N 53 W	14.2	14.3	9.5	1.62	9.61	0.305	...
16	.427	.504	.632	.5282	43.3	48.5	36.1	43.22	— 8.37	210	292	174	216	76	87	82	77	W b S	N W b N	W b N	N 78 W	6.0	17.9	14.8	13.85	15.09	0.140	...
17	.680	.758	—	—	36.8	47.6	—	—	—	164	236	—	—	75	74	—	—	S W b W	N W b N	W N W	N 62 W	11.8	11.2	3.5	6.07	7.06	...	...
18	.835	.796	.734	.7758	40.7	50.1	47.8	47.35	— 4.93	199	226	252	235	79	63	77	73	Calm.	E b S	N	N 53 E	0.0	10.0	4.2	6.48	8.39	...	...
19	.709	.688	.672	.6900	49.2	56.1	49.4	52.37	— 0.25	252	251	132	227	73	57	38	58	N E b N	E	N	N 32 E	16.4	9.2	10.0	9.51	11.85	...	...
20	.667	.586	.630	.6233	45.4	58.8	44.7	48.65	— 4.37	235	195	226	212	79	39	77	65	N b W	E b N	N W	N 12 E	15.8	9.5	0.5	5.35	8.89	...	...
21	.581	.535	.524	.5467	48.9	69.8	57.4	59.68	+ 6.37	174	279	376	271	51	39	82	55	N W b N	N W	N W b N	N 38 W	9.0	16.0	11.0	10.46	11.11	...	...
22	.543	.488	.441	.4872	51.7	61.4	54.1	56.28	+ 2.58	311	347	314	328	82	64	77	74	W S W	S b W	S b W	S 22 W	3.2	8.2	2.5	3.80	6.01	...	...
23	.455	.482	.515	.4912	55.2	68.2	55.2	60.48	+ 6.52	226	312	302	293	52	46	71	57	N W b N	S b W	S S W	S 49 W	11.2	7.7	0.3	2.24	4.71	...	...
24	.550	.476	—	—	53.0	64.2	—	—	—	277	351	—	—	70	60	—	—	S S W	E b S	S W b S	S 22 E	1.8	10.5	5.5	2.52	3.46	...	..
25	.490	.436	.468	.4640	54.5	72.5	62.1	63.85	+ 9.17	299	364	377	360	72	46	69	63	S W b S	S W b S	Calm.	S 32 W	1.6	17.0	0.0	5.06	6.16	...	...
26	.486	.460	.430	.4545	56.7	65.3	55.2	59.83	+ 4.85	368	399	369	371	84	66	86	75	N E b N	E b N	S E b E	S 77 E	2.2	3.5	1.0	4.21	5.34	Inap	...
27	.388	.344	.372	.3647	54.1	58.4	49.8	55.15	— 0.13	323	384	273	331	78	81	77	77	S b W	S S W	S S W	S 10 W	6.3	9.2	6.0	6.30	6.84	0.220	...
28	.284	.259	.315	.2812	50.5	59.3	49.6	52.15	— 3.50	287	365	306	312	80	75	88	82	E b S	S	W S W	S 20 W	5.5	14.8	1.5	6.73	7.95	0.295	...
29	.297	.356	.437	.3672	50.5	54.1	49.8	51.42	— 4.53	297	239	286	275	82	58	81	74	S W b S	W b S	Calm.	S 78 W	10.0	16.0	0.0	7.64	8.10	...	...
30	.505	.543	.536	.5330	49.8	60.6	52.1	54.78	— 1.47	278	285	276	292	79	55	72	70	W b N	S E b E	Calm.	S 60 E	0.4	5.0	0.0	1.50	2.78	.135	...
31	.499	.449	—	—	50.9	59.2	—	—	—	320	334	—	—	87	67	—	—	N E b E	E b N	E N E	N 74 E	6.2	8.5	6.5	7.28	7.38	.080	...
M	29.5525	29.5278	29.5317	29.5353	44.45	53.77	47.14	48.87	— 2.61	.230	.270	.259	.254	.78	.66	.78	.74	....	....	....	....	7.26	10.89	5.70	...	8.13	4.145	Inap

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR MAY.

Highest Barometer........................ 29.896 at 8 a. m., on 12th } Monthly range= 0.697
Lowest Barometer .... 29.199 at midn'ht, on 4th }

Self-registering Thermom.
- Maximum Temperature...............74.°8 on p. m., of 25th } Monthly range= 48.°8
- Minimum Temperature..............26.°0 on a. m. of 11th }
- Mean maximum Temperature .... 57°17 } Mean daily range= 16.94
- Mean minimum Temperature .... 40°24 }
- Greatest daily range ....26°8 from a. m. to p. m. of 21st.
- Least daily range.................. 7.4 from a. m. to p. m. of 4th.

Warmest day......... 25th ... Mean temperature......... 63°85 } Difference = 31°90.
Coldest day.......... 11th ... Mean temperature......... 31.95 }

Maximum. { Solar.................................... 90°5 on 25th, p. m. } Monthly range= 72°5
Radiation. { Terrestrial.................................. 18°0 on 11th, a. m. }

Aurora observed on 3 nights, viz., 7th, 8th and 13th.
Possible to see Aurora on 17 nights; impossible on 14 nights.

Snowing on 1 day.—depth Inap. inches; duration of fall 0.5 hours.
Raining on 15 days,—depth 4.145 inches; duration of fall 94.8 hours.

Mean of cloudiness = 0.61.
Most cloudy hour observed, 4 p. m., mean = 0.80; least cloudy hour observed, 10 p. m., mean, =0.50.

Sums of the components of the Atmospheric Current, expressed in miles.

North.	South.	East.	West.
2224.37	1448.93	1835.40	2172.53

Resultant direction N. 23° W.; Resultant Velocity 1.14 miles per hour.
Mean velocity.......................... 8.13 miles per hour.
Maximum velocity .... 29.8 miles from noon to 1 p. m. on the 10th.
Most windy day....................... 10th ...Mean velocity 22.39 miles per hour.
Least windy day .... 30th...Mean velocity 2.78 ditto.
Most windy hour ... noon to 1 p. m.......Mean velocity 11.83 ditto. } Difference 7.07 miles.
Least windy hour ... midnight to 1 a. m..Mean velocity 4.76 ditto. }

Solar Halos on the 13th noon to 4 p. m., 22nd 10.30 a. m. to 1.30 p. m., 26th at 8 a. m., and 30th Halo and Parhelia during the evening.

Lunar Halo on the 2nd at 10 p. m.—imperfect.

Hoar Frost on the mornings of the 7th, 8th and 17th.

Ice on the pools on the mornings of the 11th, 12th, 13th and 18th.

Thunder on the 10th, at 2 a. m. (distant). Thunderstorm on the 16th, from 1 to 1.30 p. m.

Sheet Lightning on 25th at 9 p. m., and 26th at midnight.

Very perfect Rainbow with supplementary band on the 7th at 5.15 p. m.

Fog on the 2nd and 5th.

The resultant direction of the wind, from 1848 to 1857, for the month of May was N. 13° W., and the resultant velocity 1.35 miles.

COMPARATIVE TABLE FOR MAY.

Year.	Temperature.					Rain.		Snow.		Wind.		
	M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range.	No. of days.	Inch's.	No. of days.	Inch's.	Resultant. Direction.	Resultant. V'y.	Mean Force or Velocity.
	°	°	°	°	°							
1840	53.8	+2.5	74.5	30.8	43.7	9	4.150	...	...	...	...	....
1841	50.5	−0.8	76.2	26.6	49.6	11	2.350	1	...	...	...	0.35 lbs.
1842	49.1	−2.2	74.3	30.0	44.3	7	1.275	...	...	...	...	0.53
1843	49.1	−2.2	79.6	28.9	50.7	5	1.570	...	0.0	...	...	0.52
1844	53.6	+2.3	77.7	29.0	48.7	14	5.670	...	0.0	...	...	0.30
1845	49.6	−1.7	76.6	29.4	47.2	8	2.300	...	0.0	...	...	0.55
1846	55.5	+4.2	78.1	34.3	43.8	9	4.375	...	0.0	...	...	0.46
1847	54.4	+3.1	72.5	27.8	44.7	12	2.040	...	0.0	...	...	0.29
1848	54.1	+2.8	78.5	31.9	46.6	13	2.520	...	0.0	N 40° W	1.31	4.93 miles
1849	48.0	−3.3	72.5	32.7	39.8	16	5.115	...	0.0	N 51° E	1.97	5.33
1850	47.6	−3.7	76.3	31.1	45.2	7	0.545	1	Inapp	N 64° W	2.05	6.32
1851	51.3	0.0	73.2	28.7	44.5	12	2.950	1	0.5	N 32° W	1.59	6.34
1852	51.4	+0.1	73.3	34.5	38.8	7	1.125	1	Inapp	S 82° W	0.99	4.00
1853	50.9	−0.4	78.4	38.4	40.0	17	4.420	1	Inapp	N 20° W	0.9[illegible]	5.14
1854	52.2	+0.9	69.0	27.6	41.4	11	4.630	...	0.0	S 66° E	0.26	5.38
1855	53.1	+1.8	74.8	33.9	40.9	6	2.565	2	0.9	N 1° W	2.76	5.93
1856	50.5	−0.8	80.1	35.5	44.6	14	4.580	1	Inapp	N 4° E	3.99	9.81
1857	48.9	−2.4	72.5	27.9	44.6	15	4.145	1	Inapp	N 23° W	1.14	8.13
M	51.31	...	75.45	31.05	44.39	10.7	3.129	0.5	0.08			6.13 miles

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—APRIL, 1857.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL.D.

Latitude—45 *deg.* 32 *min. North. Longitude*—73 *deg.* 36 *min. West. Height above the Level of the Sea*—118 *feet.*

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Velocity in miles per hour.			Mean direction of Wind.	Rain in Inches.	Snow in Inches.	WEATHER, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A. M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.				6 A. M.	2 P. M.	10 P. M.
1	29.365	29.443	29.641	37.9	26.5	12.6	.199	.129	.088	.83	.80	.87	sw b w	N E b N	N b E	6.60	14.42	19.77	...	...	2.14	C. Str. 10.	Snow.	C. C. Str. 6.
2	.745	.862	.087	3.1	25.2	16.1	.044	.102	.076	.80	.65	.63	W	W N W	N b E	15.77	8.33	19.40	...	...	...	Clear.	Clear.	Clear.
3	.158	.056	29.896	14.4	38.0	25.6	.073	.189	.118	.68	.76	.73	S	S S W	S E b E	1.75	1.81	2.35	...	...	...	Do.	Str. 4.	Cum. 4 L. H.
4	.738	.703	.864	24.9	51.0	39.2	.102	.255	.234	.65	.66	.89	S S E	S W E	S S W	0.15	1.70	2.81	...	...	...	Cum. Str. 6.	C. C. Str. 4.	C. Str. 4 L. H
5	.730	.535	.471	29.8	51.1	51.6	.138	.315	.337	.74	.81	.87	E N E	SE by S	S S E	2.43	5.77	9.21	...	0.116	...	Do. 10.	Nimb. 10.	Rain.
6	.211	.224	.213	50.0	48.1	31.0	.336	.302	.171	.88	.86	.89	S S E	S S E	N W	24.82	12.20	12.53	...	0.705	1.20	C. C. Str. 10.	Rain.	Snow.
7	.494	.696	.922	21.2	32.1	25.9	.118	.160	.112	.88	.80	.70	S W	S W	S W	14.37	16.23	11.10	...	...	1.50	C. St. 4.	C. Str. 4.	C. Str. 2.
8	.986	.765	.864	31.3	37.1	40.0	.153	.199	.237	.78	.83	.86	S E by S	S E b S	S	5.31	6.73	6.62	...	Inp.	...	Do. 10.	Do. 10.	Do. 10.
9	.860	.848	.518	36.4	42.2	35.0	.192	.243	.203	.83	.85	.90	S	W S W	W	9.48	2.31	1.85	...	0.533	...	Rain.	Do. 10.	Do. 8.
10	.883	.814	.765	32.0	39.1	36.0	.188	.220	.218	.90	.89	.94	N N E	N E	N E	1.33	6.63	17.43	...	0.103	...	C. C. Str. 4.	Do. 6.	Rain.
11	.538	.534	.710	35.0	44.6	37.2	.203	.211	.218	.91	.85	.91	N N W	S S W	S	19.86	0.66	2.18	...	0.436	...	Cum. Str. 10.	Do. 6.	C. Str. 10.
12	.680	.657	.722	35.8	53.0	39.4	.210	.299	.233	91	.73	.89	W S W	S	S b E	4.20	2.12	1.76	...	...	...	Do. 4.	Cum. Str. 2.	Do. 4.
13	.785	.804	.799	32.1	53.5	41.6	.191	.293	.235	.94	.70	.85	S	E by N	S E b E	0.12	0.40	1.67	...	...	...	Clear.	Rain.	Do. 6.
14	.642	.358	28.982	32.7	36.2	37.0	.191	.229	.238	.93	.98	100	NE by E	NE b E	N E	1.90	20.86	29.31	...	3.196	...	Cum. Str. 10.	Cir. Str. 10.	Rain.
15	28.946	29.043	29.164	33.9	42.9	33.6	.204	.225	.187	.95	.79	.90	S W b S	W S W	S W	9.07	13.66	9.11	...	0.850	0.40	Do. 10.	Do. 2	Clr. Aur. Bor.
16	29.265	.350	.598	34.1	43.1	32.5	.178	.233	.182	.83	.79	.90	W S W	W S W	S W	9.72	10.61	9.77	...	...	...	Do. 4	Do. 8.	Do.
17	.650	.601	.565	31.4	42.6	40.9	.171	.225	.235	.88	.79	.85	N N E	NE by E	N N W	2.77	10.40	7.73	...	...	...	C. C. Str. 10.	Do. 10.	C. Str. 8.
18	.628	.710	.764	39.1	42.9	38.0	.214	.252	.227	.86	.85	.92	W S W	N E b E	NE b N	7.41	8.83	1.57	...	...	...	Do. 9.	Do. 9.	C. C. Str. 4.
19	.851	.721	.689	40.4	55.0	42.6	.227	.342	.261	.88	.76	.89	E N E	S E	S E b S	8.47	3.41	7.27	...	...	...	Clear.	Do. 10.	C. Str. 10.
20	.723	.593	.599	37.1	45.6	44.6	.199	.262	.283	.84	.81	.89	E by S	N E b E	NE b N	6.20	13.80	3.72	...	...	...	C. C. Str. 4.	Cir. Str. 4.	Do. 10.
21	.578	.583	.644	38.2	46.9	38.0	.207	.284	.194	.84	.82	.80	N E b E	N E b E	E N E	24.12	14.76	17.86	...	...	...	Cum. Str. 4.	C. C. Str. 4.	Clear.
22	.610	.513	.566	36.4	54.3	41.5	.192	.304	.201	.83	.76	.79	N E b. E	N E b E	N E b E	10.15	9.92	5.60	...	...	...	Clear.	C. Str. 10,	C. Str. 4.
23	.575	.564	.609	35.0	54.2	38.9	.186	.326	.179	.83	.76	.74	N N E	N E b E	S S E	4.01	0.63	1.92	...	Inp.	...	Cum. Str. 6.	C. C. Str. 4.	Do. 4.
24	.560	.533	.604	42.1	53.9	42.2	.242	.264	.199	.85	61	.68	E S E	W by S	W S W	6.22	8.00	16.92	...	...	...	Str. 2.	Cum. Str. 8.	Do. 2.
25	.573	.614	.680	36.0	29.0	34.1	.192	.196	.162	.83	.76	.76	W b N	N W	W b N	4.01	10.30	3.43	...	...	...	C. Str. 4.	Cum. 4.	Do. 2.
26	.683	.670	.700	32.3	37.4	37.0	.167	.274	.198	.83	.70	.77	W b N	W by N	S E	1.55	4.93	1.10	...	...	...	Clear.	Do. 4.	Clear.
27	.310	.356	.415	32.4	34.4	32.5	.160	.178	.191	.80	.83	.95	S E	S E b S	E b N	1.92	4.57	0.05	...	0.710	1.70	Cum. Str. 10.	Rain.	Snow.
28	.467	.395	.798	34.7	38.2	32.5	.195	.207	.178	.91	.84	.86	W by N	W	W	12.26	19.55	18.12	...	...	...	Do. 9.	Cir. Str. 8.	Cir. Str. 10.
29	.901	.906	30.036	28.2	46.5	32.7	.135	.227	.174	.78	.75	.83	W N W	N W	W N W	9.40	12.35	6.75	...	...	...	Clear.	Do. 4.	Clear.
30	30.149	38.146	30.180	30.0	57.0	38.2	.160	.273	.177	.86	.76	.77	NE by E	W S W	S E	0.02	0.12	6.80	...	...	...	Do.	Clear.	Do.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—MAY, 1857.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL. D.

Latitude—45 deg. 32 min. North. Longitude—73 deg, 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32° Fahr.			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Velocity in miles per hour.			Mean direction of Wind.	Rain in Inches.	Snow in Inches.	WEATHER, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A. M.	2 P. M.	10 P. M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 PM	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 PM				6 A. M.	2 P. M.	10 P. M.
1	30.018	29.837	29.817	40.4	58.2	51.1	.227	.290	.238	.85	.59	.61	S E b S	S by E	S b E	0.00	16.02	9.25	...	...	...	Cir. Cum. Str. 4	Cir. Str. 8.	Nimb. 10.
2	29.804	.568	.542	40.7	48.8	47.2	.235	.336	.349	.84	.93	.98	S by E	S by E	S	9.22	4.50	2.90	...	.543	...	Rain.	Rain.	Cir. Str. 10.
3	.784	.787	.854	40.1	48.0	39.8	.245	266	.234	.85	.78	.91	W	W by N	S W	6.82	4.60	5.30	...	...	...	Cm. Str. 9.	Cir. Str. 6.	Clear Aur. Bor.
4	.866	.785	.751	36.0	54.6	46.9	.220	.349	.291	.94	.81	.85	S b E	NE byE	N E b E	1.55	2.40	1.21	...	...	...	Do. 6.	Do. 8.	Rain.
5	.600	.459	.548	40.9	39.3	36.1	.255	.245	.217	.94	.96	.98	N E b E	NE byE	N E b E	21.11	31.85	21.57	...	1.386	...	Rain.	Rain.	Cir. Str. 10.
6	.595	.650	.692	34.5	42.2	40.5	.214	.243	.245	.99	.85	.92	NE byE	N W	S S W	5.93	0.20	0.01	...	0.086	...	C. to 10.	Cir. Str. 6.	Do. 9.
7	.717	.741	.847	41.1	48.3	41.2	.253	.324	.253	.91	.92	.91	S W b S	S W	W S W	0.55	3.65	2.80	...	0.041	...	Sligh Rain.	Do. 7.	Do. 2.
8	.899	.907	.982	38.5	60.4	50.4	.226	.350	.283	.90	.66	.75	SW b W	N W	S by W	1.30	8.71	4.65	...	...	...	Clear.	Clear.	Clear.
9	.779	.612	.496	47.4	80.0	62.0	.252	.481	.397	.76	.47	.71	S by E	SW	S by E	0.76	4.76	7.05	...	...	...	Cir. Cm. St. 4.	Cir. Str. 4.	Str. 2.
10	.324	.350	.593	55.0	58.5	39.0	.399	.346	.214	.89	.70	.84	S S W	SW	NW bW	6.15	9.15	10.70	...	0.009	...	Cm. Str. 8.	Do, 9.	Rain.
11	.840	.800	.914	30.1	44.0	35.0	.145	.223	.170	.78	.73	.76	N	NE b N	N E	24.41	4.00	2.25	...	...	...	Clear.	Clear.	Clear.
12	.994	.932	.910	29.7	54.1	40.6	.152	.326	.194	.82	.76	.78	NW b N	W by S	W by S	2.12	1.65	4.40	...	...	...	Do.	Do.	Str. 2.
13	.856	.801	.819	38.6	59.5	46.6	.189	.267	.210	.76	.52	.64	S W	NW b N	N	4.00	3.97	7.81	...	...	...	Do.	Cir. Str. 6.	Clear Aur. Bor.
14	.780	.612	.570	44.1	66.0	47.6	.223	.394	.271	.73	.61	.80	NE byE	NE byE	S S E	0.41	0.52	1.36	...	...	...	Do.	Clear.	C. Str. 8.
15	.506	.465	.510	42.0	54.6	46.7	.152	.199	.282	.53	.46	.86	NE byE	N EbyE	S	11.52	6.60	0.92	...	...	...	C. to 10.	Cir. Str. 10.	Do. 10.
16	.563	.588	.670	40.1	63 6	47.0	.194	.326	.271	.73	.56	.80	N E b N	E S E	S by E	0.90	3.93	0.46	...	...	...	Cir. Cm. St. 8.	Clear.	Do. 10.
17	.696	.795	.899	42.2	42.4	41.6	.252	.243	.249	.85	.85	.86	S by E	W by N	S W	3.03	9.30	1.20	...	0.663	...	Rain.	Rain.	Clear.
18	.947	.881	.916	40.5	66.8	50.9	.210	.416	.283	.79	.65	.75	W by N	S S W	W	11.46	2.85	0.40	...	...	...	Clear.	C. Str. 4.	Cir. Cum. Str. 4.
19	.926	.861	.842	40.3	58.0	45.0	.153	.243	.202	.57	.49	64	E N E	E N E	E N E	8.61	12.67	11.85	...	...	...	Clear Frost.	Str. 2.	Str. 2.
20	.776	.715	.678	43.3	56.9	47.0	.216	.255	.252	.73	.55	.75	E N E	E	W b S	15.81	6.92	1.42	...	...	...	Do.	C. Str. 9.	Cir. Cum. Str. 9.
21	.599	.574	.579	46.1	62.4	56.8	.262	.375	.305	.80	.67	.66	S W	W N W	W N W	2.80	2.77	6.75	...	...	...	C. C. to 6.	Do. 4.	Clear.
22	.588	.564	.596	50.0	78.5	63.5	.326	.473	.366	.86	.50	.63	S	S S E	S W b W	0.00	1.15	2.21	...	...	...	Clear.	C. C. Str. 4.	Cum. Str. 9
23	.560	.527	.596	52.8	80.9	62.4	.304	.473	.397	.76	.46	.71	S S W	S S W	S W b S	0.45	4.47	2.86	...	...	...	Do.	Clear.	Clear.
24	.689	.621	.606	59.4	86.1	64.0	.283	.532	.425	.72	.43	.71	W S W	S W b S	S	0.91	1.21	2.36	...	...	...	Do.	Do.	Do.
25	.572	.488	.523	64.0	87.0	70.5	.476	.607	.489	.78	.48	.67	S W b S	W b S	SW b W	1.92	6.46	8.90	...	...	...	C. to 4.	Hazy.	Hazy.
26	.793	.840	.797	47.3	65.5	55.4	.271	.473	.312	.80	.74	.81	N E E	N by E	N N E	11.65	21.25	2.20	...	Inapp	...	Clear.	Clear.	Cir. Str. 10.
27	.641	.530	.501	62.0	79.6	67.0	.431	.568	.408	.76	.58	.61	N E	S E	S E	7.05	2.96	12.97	...	0.100	...	C. to 6.	Cir. Str. 4.	Do. 4 R. with T.
28	.555	.424	.469	51.5	77.5	55.1	.879	.588	.394	.93	.64	.88	S E	E S E	S W	5.05	1.11	4.06	...	1.434	...	Rain.	Do. 6.	Do. 8 R. with T.
29	.418	.384	.429	57.0	67.6	56.0	.432	.534	.385	.90	.81	.84	SW b W	S S W	SW b W	0.22	8.18	11.06	...	...	...	C. to 4.	C. Str. 2.	Str. 2.
30	.528	.567	.662	50.3	59.1	50.1	.326	.426	.326	.87	.84	.87	W S W	W S W	S S W	12.10	10.92	2.57	...	...	...	Do.	C. C. Str. 8.	Clear.
31	.675	.633	.663	50.0	72.0	54.2	.304	.498	.373	.80	.64	.87	S S W	S W	S S E	0.12	0.02	2.01	...	...	...	C. C. Str. 4.	Do. 4.	C. C. Str. 4 L. H.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR APRIL.

Barometer	Highest, the 30th day	30.180
	Lowest, the 15th	28.946
	Monthly Mean	29.691
	Monthly Range	1.134
Thermometer	Highest, the 13th day	55°.7
	Lowest, the 2nd day	2°.9
	Monthly Mean	37°19
	Monthly Range	52°8

Greatest intensity of the Sun's Rays ... 98°.6

Lowest point of Terrestial Radiation ... 1°.4

Mean of Humidity ... .821

Amount of Evaporation ... 1.75

Rain fell on 10 days amounting to 6.549 inches; it was raining 61 hours 46 minutes.

Snow fell on 5 days, amounting to 6.94 inches; it was snowing 26 hours 20 minutes.

The most prevalent wind was the N E by E.

The least prevalent wind E by S.

The most windy day the 21st; mean miles per hour 18.91.

Least windy day the 13th; mean miles per hour 0.73.

The Aurora Borealis visible on 1 night.

Lunar Halo visible on 2 nights.

Swallows first seen on the 19th days.

Frogs first heard on the 22nd day.

The electrical state of the Atmosphere has indicated moderate intensity.

Ozone was in rather large quantity.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR MAY.

Barometer	Highest the 1st day	30.018
	Lowest the 10th day	29 324
	Monthly Mean	29.682
	Monthly Range	0.694
Thermometer	Highest the 24th day	88°5
	Lowest the 12th day	26°.9
	Monthly Mean	51°90
	Monthly Range	61°6

Greatest Intensity of the Sun's Rays ... 122°4

Lowest Point of Terrestrial Radiation ... 24°.7

Mean of Humidity ... .753

Amount of Evaporation ... 3.010

Rain fell on 9 days, amounting to 4.232 inches; it was raining 68 hours and 42 minutes and was accompaned by thunder on 2 days.

Most prevalent wind, N. E. by E. Least prevalent wind, N.

Most windy day, the 5th day; mean miles per hour, 24.84.

Least windy day, the 31st day; mean miles per hour, 0.71.

Aurora Borealis visible on 2 nights.

Lunar Halo on 1 night.

Shad first caught on the 24th day.

The electrical state of the atmosphere has indicated moderate intensity.

Ozone was in small quantity.

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No. XI.—SEPTEMBER, 1857.

THE ARIZONA COPPER MINE.

BY JAMES GILBERT.

Read before the Canadian Institute, 13th December, 1856.

Various causes have combined to excite a greatly increasing interest in the mineral wealth of this continent; and while our own valuable, though still unwrought, Canadian copper region naturally forms the pre-eminent object of such interest, as pertaining to ourselves and constituting a source of future enterprise and wealth, it will not probably prove unacceptable to the Members of the Canadian Institute to learn somewhat of the mineral wealth of the south-western regions of this continent of North America, as illustrated by the Arizona mine, one of the richest copper mines hitherto noted in the mineral regions of California. At the same time the history of this mine, while it directs our attention to other depositories of unwrought mineral treasure, abundantly illustrates the obstacles which had to be overcome before such could be turned to profitable account.

The information contained in the following brief notice was acquired during a recent visit to California. The Arizona Copper Mine, is situated in the Gadsden Purchase in latitude 32° north, and longitude 111°45′ west; being about 110 miles S. E., from Fort Yuma, and 35 miles from the river Gila.

The Arizona Mining Company was formed with the object of opening certain silver mines, existing in the region of the Arizona moun-

tains, and which according to history had been worked by the Mexicans, at an early period, with extraordinary success. One in particular, known as the Planche de la Plata mine, had a wide reputation, having yielded masses of pure silver, weighing more than twenty arrobas, a Spanish weight of twenty-five pounds. Necessity, however, arising from remoteness of situation, and the war whoop of the savage, had long since occasioned the abandonment of this mine; and it was gradually sinking into oblivion, when attention was directed to it by Count Rousset. This daring Frenchman, having obtained from Santa Anna a grant of the mine in question, made an expedition to Sonora, intending to explore the Arizona mountains in search of silver, and to take possession and work the mine ceded to him.

Great and unforseen difficulties were encountered, and his followers becoming disheartened, after months of toil and privation, he was reluctantly forced to suspend, though not entirely to abandon the enterprise. Meanwhile fresh troubles befel him, which it would be foreign to our present object to enter upon; getting embroiled with the Mexican authorities, his capture, trial and execution were the consequences.

Aware of these circumstances the Arizona Company set out from San Francisco, immediately after its preliminary organization, in the latter part of 1854, with the view of taking possession of the noted silver mine; the Frenchman's right to which, it was assumed, had been confiscated by the manner of his death. Arrived in the Gadsden Purchase, the little band of adventurers, numbering twenty men, well armed, separated into detachments, one of which under Mexican guidance, succeeded in making its way to the location pointed out as the Planche de la Plata mine. There were, however, unmistakable signs of the nearness of hostile Indians, consequently, after spending a little time in examining the plain, which bore evidence of having been superficially dug over, and picking up a lump of virgin silver weighing 21 lbs. they returned to their camp, satisfied that the Planche de la Plata mine was a reality; but, at the same time, convinced that its appropriation was for the present impracticable, from its remoteness with respect to supplies, and from the hostility of the surrounding Indians. Another portion of the company, arriving at Sonorita, heard of a copper mine forty miles to the north, in a barren and unknown country; proceeding thither, and being struck with indications of the great richness of the mine, they resolved to keep possession; the remainder of the company at length joining them, the further search for silver mines was abandoned. One of the explorers

returned to San Francisco, in February, 1855, with specimens of the ore, and the company was incorporated, under the title of the "Arizona Mining Company;" hence, curiously enough, the endeavours of the association to occupy and open old silver mines, were terminated by the unexpected discovery and possession of a rich copper mine.

In the midst of mountain ridges, principally of porphyry, which rise abruptly from plains dotted here and there with grass, lies the Arizona mine. The green colour of the ore, outcropping on the dark red rock, is perceptible at the distance of a mile; numerous specimens of the cactus—one kind of which, the *cereus giganteus*, the savarre of the Mexicans, frequently attains the height of forty feet,—together with mezquit and iron wood form the principal vegetable growth. Some of the mountains bear evidence of tremendous igneous action, whilst others are void of all traces of plutonic force. The soil is light and porous, with a superabundance of disintegrated granite. Altogether the scene is lonely and desolate in the extreme; though the perpetual but scanty vegetation prevents it from meriting the appellation of a desert. Water is obtained from natural reservoirs found in the dark mountain recesses, supplied by the rains, which occur with some regularity during the months of July, August, December, January, and February.

The ores extracted are the gray, black and red oxide, the latter richly impregated with virgin copper. Persons conversant with copper mining admit the ore to be the richest, in the average, of any yet discovered. So far as examined the veins increase in richness and quantity as they remove from the surface. For instance, a vein of red oxide four inches wide at the surface, had, at the depth of fifty feet, reached the thickness of four feet, and became almost exclusively pure copper which lay in a soft rock and was easily worked.

Dr. Webster, a resident of San Francisco, largely interested in the mine, and to whose kind services I am indebted for specimens of the ore, informed me of the existence of a peculiar feature in its vicinity; a high hill known as the iron mountain, but which, more accurate observation and analyzis has since proved to be composed of the black oxide of copper, existing in immense quantities.

The knowledge of the Arizona mine was confined to a few Papago Indians, previous to 1851. In the commencement of that year some Mexicans sent a party of seven labourers to work it; six of whom were surprised and murdered by the Apache Indians. Subsequently several foreigners endeavoured to form companies and settle in its

vicinity, but obstacles, incidental to its situation, obliged them to desist. Now, however, that the energetic American has acquired a knowledge of these spots, so great in mineral wealth, and the accents of the English language have been heard in the mountain gorges, and on the plains, amid which such mineral wealth abounds, it seems natural to anticipate that the war whoop of the savage will die away. The Indian will disappear here as elsewhere, after witnessing in vain the advantages of civilization and combined industry, and thus ere long this formidable impediment will cease to baffle the exertions of science and commerce, in turning to account so rich a deposit of mineral wealth.

NARCOTIC USAGES AND SUPERSTITIONS OF THE OLD AND NEW WORLD.

BY DANIEL WILSON, LL.D.,

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(Continued from p. 264.)

Amid the endless variety which characterises the form of the ancient Mound Builders' pipes, one general type is traceable through the whole. "They are always carved from a single piece, and consist of a flat curved base, of variable length and width, with the bowl rising from the centre of the convex side. From one of the ends, and communicating with the hollow of the bowl, is drilled a small hole, which answers the purpose of a tube; the corresponding opposite division being left for the manifest purpose of holding the implement to the mouth." The authors of the "Ancient Monuments of the Mississippi Valley," express their conviction, derived from the inspection of hundreds of specimens which have come under their notice, during their explorations of the ancient mounds, that the instrument is complete as found, and was used without any such tube as is almost invariably employed by the modern Indian, and also by the modern perfume-loving oriental when he fills his chibouk with the odorous shiraz or mild latakia. The modern pipe-head of each has a large aperture for the insertion of the tube, whereas in

the ancient examples referred to, the perforation is about one sixth of an inch in diameter, and the mouth-piece flattened, and adapted to the lips, so that we can scarcely doubt the mouth was applied directly to the implement, without the addition of any tube of wood or metal. It is otherwise with examples of pipe-heads carved out the beautiful red pipe stone, the most favourite material for the pipe sculpture of the modern Indian. It would seem, therefore, that the pipe-tube is one of the characteristics of the modern race; if not distinctive of the northern tribes, from the Toltecan and other essentially diverse ancient people of Central and Southern America.

The use of tobacco, from the earliest eras of which we can recover a glimpse, pertained to both; but the pipe-head would appear to be the emblem of the one, while the pipe-stem gives character to the singular rites and superstitions of the other. The incremated pipe-heads of the ancient mound builders illustrate the sacred usages of the one; while the skill with which the Indian medicine-man decorates the stem of his medicine-pipe, and the awe and reverence with which—as will be presently shown,—the whole tribe regard it, abundantly prove the virtues ascribed to that implement of the Indian medicine man's sacred art. May it not be, that in the sacred associations connected with the pipe by the Mound Builders of the Mississippi Valley, we have the indications of contact between the migrating race of Southern and Central America, among whom no superstitious pipe usages are traceable, and the tribes of the north where such superstitions are most intimately interwoven with all their sacred mysteries?

In one, though only in one respect, a singular class of clay pipes, which has come under my notice, agrees with the ancient examples, and would seem thereby still further to narrow the area, or the era of the pipe-stem. During the summer of 1855, I made an excursion in company with the Rev. George Bell, to some parts of County Norfolk, Canada West, within a few miles of Lake Erie, for the purpose of exploring certain traces of the former natives of the locality. We found at various places along the margins of the smaller streams, and on the sloping banks of the creeks, spots where our excavations were rewarded by discovering relics of the rude arts of the Aborigines. These included awls or bodkins, and large needles, made of bone,*

* Implements of bone, precisely corresponding to some of these, are figured and described by Messrs. Squier and Davis, (page 220,) among the disclosures of the ancient mounds. Such implements, however, have pertained to the rude arts of primitive races in all ages, and where found with other samples of the same pottery in the States, have been supposed to be the implements for working the ornamental patterns on the soft clay.

several stone implements, and a considerable quantity of pottery. The specimens of rude native fictile ware considerably interested me, on account of the close resemblance they frequently bore, not only in material, but in ornamentation, to the ancient pottery of the British barrow .

The potters' art appears to have been practised to a great extent, and with considerable skill, by the ancient races of this continent; nor was it unknown to the Red Indians at the period when their arts and customs were first brought under the notice of Europeans. Adair says of the Choctaws and Natchez, that "they made a prodigious number of vessels of pottery, of such variety of forms as would be tedious to describe, and impossible to name;" and DeSoto describes the fine earthware of the latter tribe, in the seventeenth century, as of considerable variety of composition and much elegance of shape, so as to appear to him little inferior to that of Portugal. The specimens found by me in County Norfolk, and elsewhere in Canada, are heavy and coarse, both in material and workmanship, and neither these nor the objects now to be described, admit of any comparison, in relation to artistic design or workmanship, with those relics of the Mound Builders' arts, or the more recent productions of Indian skill which suggest a resemblance to them.

Accompanying the rude fictile ware, spoken of, were also discovered several pipe-heads, made of burnt clay, and in some examples ornamented, like the pottery, with rude chevron patterns, and lines of dot-work, impressed on the material while soft. But what particularly struck me in these, and also in others of the same type, including several specimens found under the root of a large tree, at the Mohawk reserve on the Grand River, and presented to me by the Indian Chief and Missionary, the late Peter Jones, (Kahkewaquonaby,) was the extreme smallness of the bowls, internally, and the obvious completeness of most of such examples as were perfect, without any separate stem or mouth piece; while if others received any addition, it must have been a small quill, or straw. They at once recalled to my mind the diminutive Scottish "Elfin Pipes," and on comparing them with some of these in my possesion, I find that in the smallest of the Indian pipes the capacity of the bowl is even less than the least of those which, from their miniature proportions have been long popularly assigned to the use of the Scottish Elves. Both the pipes and the accompanying pottery, totally differ, as Mr. Kane assures me, from any of the manufactures which have come under his notice among the tribes of the North West, with whom, indeed, the potter's art appears to be wholly unknown.

The pottery thus found along with these diminutive Indian clay pipes, is obviously therefore a relic of former centuries, though exhibiting no such evidence as would necessarily suggest a remote antiquity. Similar examples found to the south of the Great Lakes, are thus described by Mr. Squier, in his Aboriginal Monuments of the State of New York: "Upon the site of every Indian town, as also within all the ancient enclosures, fragments of pottery occur in great abundance. It is rare, however, that any entire vessels are recovered. Those which have been found, are for the most part gourd-shaped, with round bottoms, and having little protuberances near the rim, or oftener a deep groove, whereby they could be suspended. A few cases have been known in which this form was modified, and the bottoms made sufficiently flat to sustain the vessel in an upright position. Fragments found in Jefferson County seem to indicate that occasionally the vessels were moulded in forms nearly square, but with rounded angles. The usual size was from one to four quarts; but some must have contained not less than twelve or fourteen quarts. In general there was no attempt at ornament; but sometimes the exteriors of the pots and vases were elaborately, if not tastefully ornamented with dots and lines, which seem to have been formed in a very rude manner with a pointed stick or sharpened bone. Bones which appear to have been adapted to this purpose are often found. After the commencement of European intercourse, kettles and vessels of iron, copper, brass, and tin, quickly superseded the productions of the primitive potter, whose art at once fell into disuse."*

In an able summary of the "Archæology of the United States," embodying a resumé of all that has been previously done, Mr. Samuel F. Haven remarks: "In order to estimate correctly the degree of skill in handicrafts possessed by the people who were found in occupation of the soil, we must go back to a time antecedent to the decline in all domestic arts which resulted immediately from intercourse with the whites. So soon as more effective implements, more serviceable and durable utensils, and finer ornaments, could be obtained in exchange for the products of the chase, their own laborious and imperfect manufactures were abandoned."† But just as this reasoning must unquestionably prove in many cases, it fails of application in relation to the absence of the potter's art among the Indians of the North West, for the substitutes found for it are of native manufacture, and present a much greater dissimilarity to the pro-

* Aboriginal Monuments of the State of New York. Page 75.

† Smithsonian Contributions. Vol. VIII. Page 155.

ducts of European art. Among the Chinooks, for example, inhabiting the tract of country at the mouth of the Columbia River, the only domestic utensils remarked by Mr. Paul Kane, as creditable to their decorative skill were carved bowls and spoons of horn, and baskets and cooking vessels made of roots and grass, woven so closely as to serve all purposes of a pitcher in holding and carrying water. In these they even boil the salmon which constitute their principal food. This is done by placing the fish in one of the baskets filled with water, into which they throw red hot stones until the fish is cooked. Mr. Kane observes that he has seen fish dressed as expeditiously by this means, as if boiled in the ordinary way in a kettle over a fire.

Keeping in view the evidence thus obtained, it will probably be accepted as a conjecture not without much probability in its favor, that the rude clay pipes referred to, found along with other Canadian relics, and especially with specimens of fictile ware no longer known to the modern Indian, furnish examples of the tobacco pipe in use in the region of the Great Lakes when the northern parts of this continent first became known to Europeans. The application of the old Indian potter's art to the manufacture of tobacco-pipes is a well established fact. Ancient clay pipes of various types and forms have been discovered and described; and in a "Natural History of Tobacco" in the Harleian Miscellany,* it is stated that: "the Virginians were observed to have pipes of clay before even the English came there; and from those barbarians we Europeans have borrowed our mode and fashion of smoking."

Specimens of another class of clay pipes of a larger size, and with a tube of such length as obviously to be designed for use without the addition of a pipe-stem, have also been repeatedly met with, and several from Canadian localities are in my own possession. In the Edinburgh Philosophical Journal, February, 1848, Dr. E. W. Bawtree describes a series of discoveries of sepulchral remains, accompanied with numerous Indian relics, made in the district to the south of the River Severn, between Lake Simcoe and Georgian Bay. These included specimens of the large *pyrulæ*, or tropical shells of the Florida Gulf, copper kettles, arrow heads, bracelets and other personal ornaments, of copper, beads of shell and red pipe-stone, and also various examples of the larger clay pipes: which no doubt belong to an era subsequent to intercourse with Europeans, as the same discoveries included axe-heads and other relics of iron. Another ex-

* Vol. I. Page 535. Quoted in Notes and Queries, vol. VII. Page 230.

ample of this larger form of clay-pipe figured in Dr. Schoolcraft's "History of the Indian Tribes;"* was also found within the Canadian frontier, in the peninsula lying between Lakes Huron and Erie. It was discovered in an extensive sepulchral ossuary in the township of Beverly, which contained numerous Indian relics, and among others, specimens both of the *pyrula perversa* and *pyrula spirata*. Mr. Paul Kane possesses another pipe of the same class, trumpet shaped at the bowl, and unusually well baked, which was dug up in the vicinity of the Sault St. Marie, at the entrance to Lake Superior; so that this class of relics of the nicotian art, appears to be pecularily characteristic of the Canadian frontier. Some, at least, of these Canadian pipes are of no very remote antiquity, but it is curious to note that in form they bear a nearer resemblance than any figured or described among American antiquities, to such as are introduced in ancient Mexican paintings;† nor are examples wanting of a more antique style of art. One specimen figured by Mr. Squier in his "Aboriginal Monuments of the State of New York,"‡ is thus described: "It was found within an enclosure in Jefferson County. It is of fine red clay, smoothly moulded, and two serpents rudely imitated, are represented coiling round the bowl. Bushels of fragments of pipes have been found within the same enclosure. Some appear to have been worked in the form of the human head, others in representations of animals, and others still in a variety of regular forms. . . . Some pipes of precisely the same material and of identical workmanship with those found in the ancient enclosures, have been discovered in modern Indian graves in Cayuga County. One of these in the form of a bird, and having eyes made of silver inserted in the head, is now in the possession of the author."

Pipes of baked clay of a character more nearly approximating to the sculpture of the mounds, are figured in Messrs. Squier and Davis's work. In style of art, however, they are greatly inferior. Of two of these (Figs. 76, 77, page 194,) it is remarked: "They were ploughed up in Virginia at a point nearly opposite the mouth of the Hocking river, where there are abundant traces of an ancient people, in the form of mounds, embankments, &c. One represents a human head, with a singular head-dress, closely resembling some of those worn by the idols and sculptures of Mexico. The other represents some animal coiled together, *and is executed with a good deal*

* Vol. I. Plate VIII. Figs. 5 and 6.
† Lord Kingsborough's Mexican Antiquities. Vol. IV. Plates 17, 57.
‡ Plate 76. Fig. 9.

of spirit." The latter remark, however, is scarcely borne out by the accompanying illustration, and it seems by no means improbable that these objects furnish specimens of the Indian arts of Virginia in the time of Raleigh. They certainly present no such marked characteristics as to justify their classification with the ingenious sculptures of the Mound Builders. The same remarks apply to examples procured by Schoolcraft, Squier, and other writers; and among such may be included two clay pipes, one of them found in a mound in Florida, and the other in South Carolina, and both described in the "Ancient Monuments of the Mississippi Valley."* Most of the ancient clay pipes that have been discovered are stated to have the same form; and this, it may be noted, bears so near a resemblance to that of the red clay pipe used in modern Turkey, with the cherry-tree pipe-stem, that it might be supposed to have furnished the model. The bowls of this class of ancient clay pipes are not of the miniature proportions which induce a comparison between those of Canada and the early examples found in Britain; neither do the stone pipe-heads of the Mound Builders, suggest by the size of the bowl, either the self denying economy of the ancient smoker, or his practise of the modern Indian mode of exhaling the fumes of the tobacco, by which so small a quantity suffices to produce the full narcotic effects of the favorite weed. They would rather seem to confirm the indications derived from other sources, of an essential difference between the ancient smoking usages of Central America and of the Mound-Builders, and those which are still maintained in their primeval integrity among the Indians of the North West.

Great variety of form and material distinguishes the pipes of the modern Indians; arising in part from the local facilities they possess for a suitable material from which to construct them; and in part also from the special style of art and decoration which has become the traditional usage of the tribe. The favourite red pipe-stone of the *Couteau des Prairies*, has been generally sought after, both from its easiness of working and the beauty of its appearance. The region of its celebrated quarries is connected with curious Indian traditions, and the locality appears to have been consecrated for many generations, as a sacred neutral ground whereon parties of rival tribes might freely assemble to supply themselves with the material requisite for their pipe manufacture, as secure from danger as when the peace-pipe has been smoked, and the tomahawk buried by the Chiefs of the Indian nations. A pipe of this favourite and beautiful

* Smithsonian Contributions. Vol. I. Page 194. Fig. 80.

material, found on the shores of Lake Simcoe, and now in my possession, measures five and three quarter inches in length, and nearly four inches in greatest breadth, yet the capacity of the bowl hollowed in it for the reception of tobacco is even less than in the smallest of the "Elfin Pipes." In contrast to this, a modern Winnebago pipe recently acquired by me, made of the same red pipe stone, inlaid with lead and executed with ingenious skill, has a bowl of large dimensions illustrative of Indian smoking usages modified by the influence of the white man.

From the red pipe stone, as well as from limestone and other harder rocks, the Chippeways, the Winnebagos, and the Siouxs, frequently make a peculiar class of pipes, inlaid with lead. Mr. Kane has in his possession an ingeniously carved red stone Sioux pipe, in form of a human figure, lying on the back, with the knees bent up towards the breast, and head thrown forward. The hollowed head forms the bowl of the pipe, while the tube is perforated through the annus; as is the case with another, but much ruder example of pipe sculpture, carved from a light colored sandstone found on the Niami River, Ohio.*

The Chinook and Puget Sound Indians, who evince little taste in comparison with the tribes surrounding them, in ornamenting their persons or their warlike and domestic implements, commonly use wooden pipes. Sometimes these are elaborately carved, but most frequently they are rudely and hastily made for immediate use; and even among these remote tribes of the flat head Indians, the common clay pipe of the fur trader begins to supersede such native arts.

Among the Assinaboin Indians a material is used in pipe-manufacture altogether peculiar to them. It is a fine marble, much too hard to admit of minute carving, but taking a high polish. This is cut into pipes of graceful form, and made so extremely thin, as to be nearly transparent, so that when lighted the glowing tobacco shines through, and presents a singular appearance when in use at night or in a dark lodge. Another favourite material employed by the Assinaboin Indians is a coarse species of jasper also too hard to admit of elaborate ornamentation. This also is cut into various simple but tasteful designs, executed chiefly by the slow and laborious process of rubbing it down with other stones. The choice of the material for fashioning the favourite pipe, is by no means invariably guided by the facilities which the location of the tribe affords. A suitable stone for such a purpose will be picked up and carried hundreds of miles. Mr.

* Monuments of the Mississippi Valley. Page 247. Fig. 146.

Kane informs me that, in coming down the Athabaska River, when drawing near its source in the Rocky Mountains, he observed his Assinaboin guides select the favourite blueish jasper from among the water worn stones in the bed of the river, to carry home for the purpose of pipe manufacture, although they were then fully five hundred miles from their lodges. Such a traditional adherence to a choice of material peculiar to a remote source, may frequently prove of considerable value as a clue to former migrations of the tribe.

Both the Cree and the Winnebago Indians carve pipes in stone, of a form now more frequently met with in the Indian curiosity stores of Canada and the States than any other specimens of native carving. The tube, cut at a sharp right angle with the cylindrical bowl of the pipe, is ornamented with a thin vandyked ridge, generally perforated with a row of holes, and standing up somewhat like the dorsal fin of a fish. The Winnebagos also manufacture pipes of the same form, but of a smaller size, in lead, with considerable skill.

Among the Cree Indians a double pipe is occasionally in use, consisting of a bowl carved out of stone without much attempt at ornament, but with perforations on two sides, so that two smokers can insert their pipe-stems at once, and enjoy the same supply of tobacco It does not appear, however, that any special significance is attached to this singular fancy. The Saultaux Indians, a branch of the great Algonquin nation, also carve their pipes out of a black stone, found in their country, and evince considerable skill in the execution of their elaborate details. In the curious collection of pipes now in the possession of G. W. Allan, Esq., and including those obtained by Mr. Kane among the Indians of the north-west, are two Chippeway pipes carved by the Indians bordering on Lake Superior, out of a dark close-grained stone, easily wrought and admitting of considerable minuteness of detail. One of these, (Plate II. Fig. 2,) measuring six and a half inches long, consists of a quadrangular tube, from which rises the bowl in the shape of a human head, of very sphynx-like aspect; and with white beads inserted for the eyes; behind this an Indian seated on the ground holds his hands to each side of the head, (colossal in proportion to him,) in front is another Indian seated on a chair, and before him stands a third figure neatly carved out of the red pipe stone, while between them is a miniature barrel cut from a white stone found chiefly on St. Joseph's Island. All the figures are well proportioned and carved with considerable minuteness of detail. Some of the details in this example—the chair and the barrel,—are obviously borrowed from European models,

but the general design is purely Indian; the figures are further completed with native head dresses of feathers, and the whole conception and execution well illustrate the usual style of the more elaborate Chippeway pipe sculptures.

One of the most celebrated of these Indian pipe sculptors is *Pabahmesad*, or the Flier, an old Chippeway still living on the Great Manitouanin Island in Lake Huron; but more generally known as *Pwahguneka*: the Pipe Maker, literally "he makes pipes." Though brought in contact with the Christian Indians of the *Mahnetooahning*, or Manitoulin Islands, Dr. O'Meara informs me that he resolutely adheres to the pagan creed and rites of his fathers, and resists all the encroachments of civilization. His materials are the *muhkuhdapwahgunahbeck*, or black pipe-stone of Lake Huron, the *wahbepwahgunahbeck*, or white pipe-stone, procured on St. Joseph's Island, and the *miskopwahgunahbeck*, or red pipe-stone of the Couteau de Prairies. His saw, with which the stone is first roughly blocked out, is made by himself out of a bit of iron hoop, and his other tools are correspondingly rude; nevertheless the workmanship of *Pabahmesad* shows him to be a master of his art. One of the specimens of his skill has been deposited by Dr. O'Meara in the museum of Trinity College, Dublin, which, from the description I have received, appears to correspond very closely to the example figured on plate II. Another of the Chippeway black-stone pipes in Mr. Allan's collection is a square tube terminating in a horse's head, turned back, so as to be attached by its nose to the bowl of the pipe, and on the longer side of the tube two figures are seated, one behind the other, on the ground, with their knees bent up, and looking towards the pipe bowl. A different specimen of the Chieppeway pipe, brought from the north-west by Mr. Kane, is made from the root of a red deer's horn, inlaid with lead, as in the red pipe-stone and limestone pipes already referred to as made by the Chippeways, the Winnebagos, and the Siouxs.

But the most remarkable of all the specimens of pipe sculpture executed by the Indians of the north-west, are those carved by the Babeen, or big-lip Indians; so called from the singular deformity they produce by inserting a piece of wood into a slit made in the lower lip. The Babeen Indians are found along the Pacific Coast, about latitude 54° 40′, and extend from the borders of the Russian dominions east-ward nearly to Frazer River. Some of the customs of the Babeen Indians are scarcely less singular than that from whence their name is derived; and are deserving of minute compari-

son with the older practices which pertained to the more civilized regions of the continent. This is especially the case in relation to their rites of sepulture, wherein they make a very marked distinction between the sexes. Their females are wrapped in mats, and placed on an elevated platform, or in a canoe raised on poles, but they invariably burn their male dead.

The pipes of the Babeen, and also of the Clalam Indians occupying the neighbouring Vancouver's Island, are carved with the utmost elaborateness, and in the most singular and grotesque devices, from a soft blue claystone or slate.

Their form is in part determined by the material, which is only procurable in thin slabs; so that the sculptures, wrought on both sides, present a sort of double bas-relief. From this, singular and grotesque groups are carved, without any apparent reference to the final destination of the whole as a pipe. The lower side is generally a straight line, and in the specimens I have examined they measure from two or three, to fifteen inches long; so that in these the pipe-stem is included. A small hollow is carved out of some protruding ornament to serve as the bowl of the pipe, and from the further end a perforation is drilled to connect with this. The only addition made to it when in use is the insertion of a quill or straw as a mouth piece. One of these shewn on Plate II., Fig. I., is from a drawing made by Mr. Kane, during his residence among the Babeen Indians. The original measured seven inches long. Plate III., is copied from one of the largest and most elaborate of the specimens brought back with him; it measures nearly fifteen inches long, and supplies a highly characteristic example of Babeen art.

Messrs. Squier and Davis conclude their remarks on the sculptures of the mounds, by observing: "It is unnecessary to say more than that, as works of art, they are immeasurably beyond anything which the North American Indians are known to produce, even at this day, with all the suggestions of European art, and the advantages afforded by steel instruments. The Chinooks, and the Indians of the north-western coast, carve pipes, platters, and other articles, with much neatness, from slate. We see in their pipes, for instance, a heterogeneous collection of pulleys, cords, barrels, and rude human figures, evidently suggested by the tackling of the ships trading in those seas. . . . . The utmost that can be said of them is, that they are elaborate, unmeaning carvings, displaying some degree of ingenuity. A much higher rank can be claimed for the Mound-sculptures; they combine taste in arrangement with skill in workman-

BABEEN PIPE.

Ackerman Lith. 379 Broadway N.Y.

ship, and are faithful copies, not distorted caricatures, from nature. So far as fidelity is concerned, many of them deserve to rank by the side of the best efforts of the artist-naturalists of our own day."*

This descriptive comparison with the arts of the Indians of the north-west coast is based, as the illustrations given here (Plates II. and III.) suffice to show, on deductions drawn from the examination of specimens very different from those which have been brought from the same localities, or investigated in the hands of the native sculptors, and obviously constitute the true illustrations of Indian skill and artistic design. In addition to these, however, among the varied collection of Indian relics brought by Mr. Kane from the north-west coast, there is one of the ingenious examples of imitative skill referred to by Mr. Squier, which was procured on Vancouver's Island. But while this exhibits evidence of the same skillful dexterity as the other carvings in the blue pipe-slate of the Clalam and Babeen Indians, it presents the most striking contrast to them, alike in design and style of art. It has a regular bowl, imitated from that of a common clay pipe, and is decorated with twisted ropes, part of a ship's bulkhead, and other objects—including even the head of a screw-nail,—all equally familiar to us, but which no doubt attracted the eye of the native artist from their novelty. Very different from this are the genuine native pipes. They are composed of varied and elaborate devices, including human figures, some of them with birds' and beasts' heads, and frequently presenting considerable accuracy of imitative skill. The frog is a favourite subject, represented generally of the same size as the accompanying human figures, but with a very spirited and life-like verisimilitude. In some of the larger pipes, the entire group presents much of the grotesque exuberance of fancy, mingled with imitations borrowed direct from nature, which constitute the charm of the Gothic ecclesiastical sculptures of the thirteenth century. The figures are grouped together in the oddest varieties of posture, and ingeniously interlaced, and connected by elaborate ornaments ; the intermediate spaces being perforated, so as to give great lightness of appearance to the whole. But though well calculated to recall the quaint products of the medieval sculptor's chisel, so far are these Babeen carvings from suggesting the slightest resemblance to European models, that when first examining them, as well as specimens in bone and ivory from the same locality,—and still more so, some ivory carvings executed by the Tawatin Indians on Frazer River,—I was struck with certain

* Monuments of the Mississippi Valley, p. 272.

resemblances to the peculiar style of ancient Mexican Art. Such resemblances may be fanciful or accidental. To me at least they were suggested by no preconceived theory of Mexican migration, as investigations in another direction have inclined me to adopt ideas even less suggestive of such than those generally set forth by American ethnologists. But while the sculptured Babeen and Clalam pipes cannot be compared to some of the more faithful imitations of objects of nature from the mounds, they furnish very noticeable proofs of imitative skill, and are well worthy of consideration as specimens of modern native art, which, if found in the ancient mounds, would have excited no less wonder and admiration than many of the relics figured from among their disclosures.

But there is another conclusion, of more general application, suggested to me by these Babeen sculptures. They are deserving of special consideration, from illustrating, in some respects, the just method of inductive history, as derived from ancient relics. Struck with the discrepancy which every careful investigator of the subject must notice between the elaborate art of the finer sculptures, and especially the pipe-heads of the mounds, and any other traces of the skill and civilization of their builders, Mr. Haven assumes a foreign origin for all such sculptures, while others have inferred from them a native civilization in the Mississippi and Ohio Valleys, corresponding in all respects to these isolated examples of art; just as, from a rude but graceful Greek vase, we can infer the taste of a Callicrates or a Phidias. But it is important to note, that while the Babeen sculptor executes a piece of pipe-carving so elaborate and ingenious as justly to excite our wonder and admiration, it furnishes no test of his general progress in arts or civilization, for, on the contrary, he is ruder and more indifferent to the refinements of dress and decoration than many Indian tribes who produce no such special examples of ingenious skill. Some of the conclusions which such facts suggest will, I suspect, be found applicable to not a few of the deductions derived by European archæologists from isolated examples of primitive art.

The pipe, however, which presents so many and characteristic forms, among the Indian tribes of the far west, whatever may have been its importance in ancient times, is no longer the special object of sacred associations. It is to the pipe-stem that the modern Indian attaches that superstitious veneration which among the Mound Builders would appear to have pertained to the pipe itself. The medicine pipe-stem is the palladium of the tribe, on which

depends its safety in peace and its success in war, and it is accordingly guarded with all the veneration, and surrounded with the dignity, befitting so sacred an institution ; while, in its use in the war-council, or in the medicine dance, so long as the proper and consecrated pipe-stem is employed, it matters not whether the pipe itself be of the richest carving of which the red stone of the *couteau des prairies* is susceptible, or be the begrimed stump of a trader's English "clay."

The medicine pipe-stem carrier is accordingly an office of great dignity in the tribe, and its holder is endowed with special, though somewhat burdensome, honors and privileges. A highly ornamental tent is provided for his use, and frequently he is required to have so many horses as renders the office even more onerous than honourable. A bear-skin robe is set apart for wrapping up the medicine pipe-stem, when carried, and for laying it on while exposed to view. When wrapped up in its covering, the pipe-stem is usually carried by the favourite wife of the dignitary, while he himself bears in his hands—and not unfrequently on his head—the medicine bowl, out of which he takes his food. But though the sacred pipe-stem is almost invariably borne by the wife of the Indian dignitary, it is never allowed to be uncovered in the presence of a woman, and should one even by chance cast her eyes on it when thus exposed, its virtues can only be restored by a tedious ceremony, designed to counteract the evil effects and to propitiate the insulted spirit. If the stem is allowed to fall to the ground, whether designedly or from accident, it is in like manner regarded as an omen of evil, and many elaborate ceremonies have to be gone through before it is reinstated in its former favor and beneficent influence. Mr. Kane met with a young Cree half-breed who confessed to him that, in a spirit of daring scepticism, he had once secretly thrown down the medicine pipe-stem and kicked it about; but soon after its official carrier was slain, and such misfortunes followed as left no doubt on his mind of the awful sacredness pertaining to this guardian and avenger of the honor of the tribe. The sacredness which attaches to the medicine pipe-stem pertains in part also to its bearer. Many special honors are due to him, and it is even a mark of disrespect, and unlucky, to pass between him and the fire.

At Fort Pitt, on the Sascatchewan River, Mr. Kane informs me that he met with Kea-keke-sacowaw, the head chief of the Cree nation, then engaged in raising a war party to make war on the Blackfeet. He had accordingly eleven medicine pipe-stems with

him, gathered from the different bands of the tribe who had already enlisted in the cause, and each committed to him by the medicine-man of the band. Armed with these sacred credentials, he proceeds through the encampments of his nation, attended by a few of his own immediate followers, but without the pipe-stem bearers, whose rights and privileges pass for the time being to the chief. Whenever he comes to an encampment he calls on the braves to assemble, tells them he is getting up a war party, recounts to them the unavenged wrongs of the tribe, recalls the names of those slain in former feuds with the Blackfeet, and appeals to them to join him in revenging their death. Throughout such an oration the tears stream down the cheeks of the excited orator, and this is styled "crying for war." On such occasions the medicine pipe-stems are not uncovered, but Mr. Kane having persuaded the Cree Chief to sit for his portrait, he witnessed the ceremony of "opening the medicine pipe-stem," as it is called, and during its progress had to smoke each of the eleven pipes before he could be allowed to commence his work. His spirited portrait represents the grim old chief, decorated with his war-paint, and holding in his hand the medicine pipe-stem, elaborately adorned with the head and plumes of an eagle.

In the grave ceremony of opening the medicine pipe-stem, the Crees make use of a novel addition to the tobacco. It is procured from the leaves or fibres of a species of cedar or spruce, which, when dried and burnt, yields a very pleasing fragrance. A handful of this was thrown on the fire in the middle of the room, and filled it with the fragrant smoke, and some of the same was sprinkled on the top of the tobacco each time one of the medicine pipe-stems was used.

All this ceremonial, and the peculiar sanctity attached to the pipe-stem, apart from the pipe, are special characteristics of the Red Indian of the North West, of which no trace is apparent in the singular memorials of the ancient Mound Builders, or in the sculptures and paintings of Mexico. Throughout the whole elaborate illustrations of Lord Kingsborough's great work it is difficult to discover a trace of Mexican usages connected with the tobacco-pipe, and in no one can I discern anything which appears to represent a pipe-stem. In volume IV, plate 17, of a series copied from a Mexican painting preserved at Pass, in Hungary, a figure coloured as a black carries in his hand a plain white pipe, already referred to as somewhat of the form of the larger clay pipes found in Canada and in the State of New York, and from the bowl rises yellow

flames. On plate 57 of the same volume, copied from a Mexican painting in the Borgian Museum, in the College of the Propaganda at Rome, may be seen another figure, holding what seems a small clay tobacco pipe, from whence smoke proceeds. One or two other pictures appear to represent figures putting the green tobacco leaf, or some other leaf, into the pipe, if indeed the instrument held in the hand be not rather a ladle or patera. But any such illustrations are rare, and somewhat uncertain; and it appears to be undoubted that the tobacco pipe was not invested in Central America with any of those singular and sacred attributes which we must believe to have attached to it among the ancient Mound Builders of the Mississippi Valley; and which under other, and no less peculiar forms, are reverently maintained among the native tribes of the North-West, constituting one of the most characteristic peculiarities of the American aborigines, and one well deserving of the careful study of the Ethnologist.

Assuming it as a fact, demonstrated by a variety of independent evidence, that the singular practice of smoking narcotics originated among the native tribes of America, and was communicated for the first time to the Old World, after its discovery by Columbus, it becomes a subject well worthy of consideration how rapid and universal was the diffusion of this custom throughout the world. Not only have Europe and Asia, in later times, disputed with America the origin of this luxurious narcotic art; but travellers who return from the mysterious tropical centre of old Africa find there, in like manner, the use of the tobacco pipe, among tribes to whom the sight of the first white man is strange and repulsive. Such facts are worthy of very careful consideration by the Ethnologist. They prove how fallacious is that mode of reasoning, which, in treating of the natural history of man, takes no account of the predominating influences of reason, intellect, and experience, as manifested even among the rudest savages; and seeks to apply the same law to man as the lower animals. They serve also to illustrate the indirect means by which the influences of a remote civilization may be extended, and thereby to explain some of the singular coincidences with which the Archæologist is familiar, in the traces of widely diffused primitive arts.

The daring traveller Charles John Andersson, the first explorer of the country of the Damaras, in his "Lake Ngami," furnishes the following interesting account of the African use of the weed:

"The Hill-Damaras subsist chiefly upon the few wild roots which their sterile

neighbourhood produces. Most of them, however, manage to raise a little tobacco, for which they have a perfect mania, and which they value nearly as much as the necessaries of life.

"They also cultivate 'dacka,' or hemp, not as with us, for its fibre, but for the sake of the young leaves and seeds, which they use as a substitute for tobacco, and which is of the most intoxicating and injurious character. It not unfrequently happens, indeed, that those who indulge too freely in the use of this plant are affected by disease of the brain.

"The manner in which the Hill-Damaras smoke is widely different from Hindu, Mussulman, or Christian. Instead of simply inhaling the smoke, and then immediately letting it escape, either by the mouth or nostril, they swallow it deliberately. The process is too singular to be passed over without notice. A small quantity of water is put into a large horn,—usually of a Koodoo,—three or four feet long. A short clay pipe, filled either with tobacco or dacka, is then introduced, and fixed vertically into the side, near the extremity of the narrow end, communicating with the interior by means of a small aperture. This being done, the party present place themselves in a circle, observing deep silence; and with open mouths, and eyes glistening with delight, they anxiously abide their turn. The chief man usually has the honor of enjoying the first pull at the pipe. From the moment that the orifice of the horn is applied to his lips he seems to lose all consciousness of everything around him, and becomes entirely absorbed in the enjoyment. As little or no smoke escapes from his mouth, the effect is soon sufficiently apparent. His features become contorted, his eye glassy and vacant, his mouth covered with froth, his whole body convulsed, and in a few seconds he is prostrate on the ground. A little water is then thrown over his body, proceeding not unfrequently from the mouth of a friend; his hair is violently pulled, or his head unceremoniously thumped with the hand. These somewhat disagreeable applications usually have the effect of restoring him to himself in a few minutes. Cases, however, have been known where the people have died on the spot, from overcharging their stomachs with the poisonous fumes. The Ovaoherero use tobacco in a similar manner, with this difference only, that they inhale the smoke simply through short clay pipes, without using water to cool it, which of course makes it all the more dangerous."

It would seem, alike from the American and the African modes of using the tobacco or other narcotics in smoking, and no less so from the Chinese and Malay employment of opium in a similar manner, that the primitive use of such among all races has been attended with gross intemperance. The inference, therefore, is probably not an illegitimate one, which ascribes the small size of the oldest British tobacco pipes, not to the economy or moderation of Elizabethan and Jacobite smokers, but rather to their practising the nicotian art in close imitation of its wild forest originators. This is nowhere more curiously and discriminatingly indicated than in its prescription for the cure of the mental disorder treated of by the quaint author of "The Anatomy of Melancholy," himself evidently a lover of the weed: "Tobacco, divine, rare, superexcellent tobacco,

which goes far beyond all the panaceas, potable gold, and philosopher's stones, a sovereign remedy to all diseases. A good vomit, I confess; a virtuous herb, if it be well qualified, opportunely taken, and medicinally used; but as it is commonly abused by most men, which take it as tinkers do ale, 'tis a plague, a mischief, a violent purger of goods, lands, health; hellish, devilish, and damned tobacco, the ruin and overthrow of body and soul!" Such a description of the extent to which tobacco was "commonly abused," in the early part of the seventeenth century (1621) is only explicable by such modes of partaking of it as still prevail among savage tribes, for scarcely even the grossest excesses of the modern smoker and chewer would admit of such terms of denunciation.

The growing size of the tobacco pipe, as it approaches the era of the Revolution, indicates the introduction of a contemporaneous nicotian revolution also, which adapted the pipe of the Indian medicine-man to the philosophical reveries of an English Newton; and within a century from Zacharie Boyd's association of tobacco with the dissipation of "The wine pint," enabled the devout author of the "Gospel Sonnets," to superadd to these his "Smoking Spiritualized: inserted as a proper subject of meditation to smokers of Tobacco; the first part being an Old Meditation upon smoking Tobacco; and the second a new addition to it, or Improvement of it."* In his "*improvement*" of his text the grave divine indulges in nicotian similes, such as, from less reverent hands, would seem profane; comparing the "naughty foreign weed" to "the plant of great renown," to "Jesse's flower" and "Sharon's Rose!" and "The smoke, like burning incense," to devout prayer; closing each stanza with the refrain:

"Thus think, and smoke Tobacco."

In this the fanciful moralist "improved" on an old song, which has been traced to the early part of the seventeenth century, and is still preserved on more than one Broadside of dates as early at least as 1670 and 1672. In the former of these it bears the initials "G. W." supposed to be those of George Wither, who is reputed to have found solace in the luxury it celebrates. This unlucky puritan poet, who died in 1667, is said by his unloving biographer, Anthony A'Wood, to have owed his life, on one occasion, to a bon-mot of a

* "Gospel Sonnets, or Spiritual Songs, in six parts, concerning Creation and Redemption, Law and Gospel, Justification and Sanctification, Faith and Sense, Heaven and Hell. By the late Reverend Mr. Ralph Erskine, Minister of the Gospel at Dunfermline." My copy is the 25th Edition. Edinburgh, 1797:—a sufficient evidence of the popularity which this work once had.

witty poetic rival, Sir John Denham. The royalist—as the author of the ATHENÆ OXONIENSIS relates—owed a grudge to the captive poet, some of his family estates having got into Wither's clutches. Nevertheless, he modestly prayed his Majesty not to hang him, for so long as Wither lived, he (Sir John Denham) would not be accounted the worst poet in England! Notwithstanding this slur on Wither's poetic repute, the song has evidently enjoyed great and enduring popularity, as is proved by numerous variations, and the gradual modernizing process it has gone through. The version of it which furnishes a text for the Rev. Ralph Erskine, betrays the touches of a modern hand; but in its general form it most nearly resembles the Broadside of 1672, with the antique flavour of which these "tobacco fumes" may fitly exhale their concluding whiff:

> The Indian weed, withered quite,
> Green at noon, cut down at night,
> Shews thy decay;
> All flesh is hay,
> Thus think, then drink tobacco.
>
> The pipe that is so lily white,
> Shows thee to be a mortal wight;
> Even as such,
> Gone at a touch,
> Thus think, then drink tobacco.
>
> And when the smoke ascends on high,
> Think thou behold'st the vanity
> Of worldly stuff,
> Gone at a puff;
> Thus think, and drink tobacco.
>
> And when the pipe grows foul within,
> Think on thy soul defiled with sin;
> And of the fire
> It doth require;
> Thus think, then drink tobacco.
>
> The ashes that are left behind,
> May serve to put thee still in mind,
> That unto dust
> Return thou must;
> Thus think, then drink tobacco.

Most of the foregoing pages were already thrown off when the *Gateshead Observer*, of June 6th, 1857, reached me, with the following notice of proceedings at a meeting of the Society of Antiquaries

of Newcastle-on-Tyne. It may very fitly be appended as a note to this sketch, as sufficing to show the latest views of my friend, Dr. Bruce, on the antiquity of pipes and tobacco. It will be seen that he still speaks of the miniature Elfin pipes as *medieval;* but subsequent remarks seem to indicate that by this term he means the era of Queen Elizabeth, if not indeed that of the Revolution, though neither of them would be generally recognised as pertaining to the province of the medieval historian.

"A PAPER—OF TOBACCO."

"Dr. Bruce said, when the circular convening the meeting was issued, there was no paper in prospect, and he had therefore written a short one, not anticipating the many interesting communications which had filled up the meeting so agreeably. His paper was on the subject of the clay-pipes occasionally found in situations where we should only expect to find remains of a time long anterior to that of Sir Walter Raleigh. To this subject his attention had been turned, within the last few days, by a letter received by the Treasurer (Mr. Fenwick) from a mutual friend—Dr. Daniel Wilson, of Toronto. The Doctor wrote.—'What says Dr Bruce to the Roman tobacco-pipes now? Tell him I have got a crow to pluck with him for that. I get quoted from his pages, and held responsible for much more than I ever thought, said, or meant to say. Let him look-out for a missive from the land of tobacco.' The passage referred to, in his (Dr. Bruce's) second edition of 'The Roman Wall,' had, curiously enough, and vexatiously enough, been more quoted and translated, perhaps, than any other. It asked if smoking pipes must be numbered among Roman remains—such pipes, (some of the ordinary size, others of pigmy dimensions, with intermediate sizes,) having been found in Roman stations, in close association with remains of undoubted Roman origin. Dr. Wilson was quoted on the subject, where, in his Archæology of Scotland, he speaks of "Celtic," "Elfin," or "Danes'" pipes, occasionally found under circumstances raising the supposition that tobacco was only introduced as a superior substitute for older narcotics. Dr. Bruce produced several specimens—one, a tiny bowl, dug from a depth of ten feet, in 1854, at the back of the Assembly Rooms of Newcastle, where, when a sewer under the Vicarage House was in course of construction, he was on the look-out for remains of the Roman Wall. In the Antwerp Museum, such pipes are exhibited as Roman antiquities; and some were found near the foundations of the Wall of Roman London, when laid bare in 1853. Still, to Dr. Wilson's Transatlantic inquiry: 'What says he to the Roman tobacco pipes now?' he had to reply, that he feared they were but medieval, and, moreover, of a late date. He would briefly state the grounds of this conclusion:—1. They were only met with, here and there, in connection with Roman remains; while in every Roman station, all the kinds of pottery used by the Romans were invariably found.—2. No traces of the practice of smoking presented themselves in classic authors.—3. Ancient herbals contained no notice of any vegetable used for smoking with pipes.—4. These old pipes, laid together, exhibited a regular gradation in size, from the fairy bowl to the pipe of the present day.—5. Elfin pipes were found some few years ago at Hoylake, in Cheshire, on the site where the troops of William III. were encamped previous to their embarkation for Ireland; on the battle-field of Boyne, at Dundalk, and in other parts of Ireland where William's

troops were quartered. 'With respect,' said one of his (Dr. Bruce's) reviewers, 'to the little tobacco pipe bowls, we may observe that their comparatively diminutive size may be well explained by the fact that, in the time of Queen Elizabeth tobacco was sold at five guineas the ounce, and that, in aftertimes, those who indulged in the expensive luxury of smoking tobacco, were accustomed, in buying it, to throw five shilling pieces into the opposite scale.' He (Dr. Bruce) feared, then, that the Elfin pipes—the Fairy pipes—the Danes' pipes—must be placed in the same category with—'Severus' Wall!'

"At the conclusion of the paper, Mr. E. Spoor stated that he had seen turned up, in building operations, hundreds of pipes together, smaller than any of those on the table, near the town walls of Newcastle."

From this it appears that the learned author of "THE ROMAN WALL," no longer accords to his mural Legionary the luxury of a pipe; and the defence of this venerable classic institution must be resigned to the more chivalrous archæologists of the Continent, and especially to the Antiquaries of Antwerp, where Elfin tobacco-pipes are still exhibited as Roman relics; and among whom, we trust, still survives some collateral descendant of the venerable and praiseworthy Aldobrand Oldenbuck, the happy progenitor of the Laird of Monkbarns!

CANADIAN ENGLISH.

BY THE REV. A. CONSTABLE GEIKIE.

Read before the Canadian Institute, 28th March, 1857.

It is a growing opinion that the English tongue is destined to become, for many purposes at least, the language of the world. But supposing such an extension of our vernacular to be probable, will the world speak "English undefiled," or English very defiled indeed? I know nothing of the tendencies in Australia, New Zealand, or at the Cape; but certainly, the English we often hear spoken, and see written, in the United States and Canada, is by no means an improvement on the original. That the American retains some obsolete words, or uses current words in obsolete ways, cannot fairly be objected to, though the very same reasons justify the language of modern Quakerism. But this process will account for a small fraction of the pecularities of his language. He is daily inventing

words which are neither English in character, nor needed to supply any deficiency in the language ; and even where peculiar circumstances may make such a coinage, or such perversion of words from their primary significance pardonable, the circumstances are continually disregarded, and they are applied in cases where no such need exists, to the exclusion of the proper phrase, and to the injury of the language.

Canada inevitably partakes of the same influences. Her language is largely affected by such lawless and vulgar innovations. New words are coined for ourselves by a process similar to that which calls them into being in the neighbouring States ; still more, they are imported by travellers, daily circulated by American newspapers, and eagerly incorporated into the language of our Provincial press. The result is that, with that alacrity at sinking which belong to human nature, we are in a fair way of appropriating what is worthless in the word coinage of our neighbours, in addition to all which our peculiar position may generate among ourselves.

It is not necessary to attempt any methodic classification of words or phrases ; the purpose of this paper will be sufficiently accomplished by noticing a few of the most characteristic novelties as they occur to me. Neither shall I make any distinction between obsolete words and modern inventions. It is enough if it can be shown that words, unrecognized by good authors, are daily used ; that words duly recognized are used in improper ways ; or that extraordinary creations, and combinations of letters and phrases, are extensively circulated without supplying a recognized want, or contributing in any sense to the enrichment of the language. To refer, then, to a few examples of such transatlantic innovations on the English language : when Englishmen wish to mark their sense of the services of some public personage, by a suitable testimonial, they are said to *give* or *present* something to him, and the thing so *given* or *presented* is called a *gift* or *present*. But with us it is becoming fashionable to speak of such a gift as a *donation*, and still more of a thing *donated*. A minister is, with peculiar delicacy, dragged up before two or three hundred people and a band of music, to receive a *present* from his congregation, of a horse, it may be, or a purse of money,—and this gift, dubbed a *donation*, is *donated* to him at what is called a *donation-meeting*. Webster says, that *donation* is usually applied to things of more value than *presents* ; but while such may be true in the States, I have known it applied here to a basket of musty cakes. I suppose that *donation*, has a certain meaning in law. Its most ordinary English application is to a single gift in money, in contra-distinction to the periodical

payments of a fixed sum as subscription. When applied to a *present*, public or private, I apprehend such an application of the teım has its origin in mere pomposity. The language stands in need of no such expression so long as we have our old Saxon *gift*.

In England, when one man accommodates another with the use of money for a time, he lends it. The sum is called a *loan*, but he who provides it is said to *lend* or to have *lent*. Here, however, it is becoming usual to speak of having *loaned* to another. Webster says that *to loan* is rarely used in England, and I may say that I never heard it there. What advantage then does it possess over the more familiar form of the verb that it should supersede it here? Surely the phrase "money to lend," is sufficiently intelligible. To talk of *loaning* money, would suggest to an unsophisticated Englishman, the idea of some unknown process at the mint.

Again, let a clergyman study his sermon, a professor his lecture, a member of Parliament his speech, or a merchant the state of the markets and the rate of exchange: an educated or uneducated Englishman would probably say, "*the man is master* of his subject," and than this, more need not and cannot be said. In the States and Canada, however, a new phrase is current. A member of our Assembly makes a luminious speech, say about that great *institution* of modern civilization, the gallows,—and writers forthwith remark, that "he is *posted-up* on it." A Professor of Anatomy gives a lecture on some abtruse branch of his department of medical education, and his admiring pupils exclaim that "he is well *posted-up* on his subject." A metaphysician once more grapples with the old problem how many angels can stand on the point of a needle, and he, too is *posted-up* on it." A clergyman is *posted-up* in theology, a blacksmith in iron, a milliner in crinoline, a mother in nursery government, and an undertaker in the art of "performing" funerals, and coffining his customers. But, while ledgers may and should be "posted," it has not hitherto been the English practise to treat men so, unless they be black-legs.

A man in England possesses notable capacity, and people style him *capable*, or *able*, or *great*. In Canada he is designated *first-class*. To speak of a *first-class* carriage, or a *first-class* prize, or even a *first-class* prize ox, may be right enough, but why apply phrases with such poor associations to men of splendid intellect? Is it not enough that a man be *great?* Will he seem any greater when indissolubly associated with a railway van? The originators of such expressions no doubt thought so, but if the victim of such a nick-name be what it is supposed to imply, he will not thank his admirers for the compliment.

A man in Britain buys a house, or farm, and it is said to be *in*, or more precisely, *situated in* such a street, or district, or county. Here, nobody or thing is *situated* anywhere ; all are *located*. Our farms, our houses, our congregations, our constituencies, all are *located*. We admire a mansion occupying a healthy, or commanding site, and we are told that "the *location* is good ;" a clergyman is congratulated on his incumbency, which is styled a comfortable *location;* and so on *ad infinitum*. To *locate* is a purely technical term, belonging to land-surveyors and their profession, and it is difficult to perceive any gain to the language by its application being extended beyond its original technical significance.

Ask an Englishman how much he has accomplished of a given work, and he will reply if getting on well, "a good deal." Ask the same question in our own colony, and if in a like position, the answer will be, "*considerable*." Now, *considerable* means, "worthy of consideration." Thus : "a man has a *considerable* fortune." We can understand when, in answer to the question, "how are you getting on with your mathematics?" the student replies *considerable*, or, still more elegantly, "considerable much." He means to say, "very well" and it is to be regreted that he should not say so. Or to give another specimen of the novel mode of applying this word *considerable ;* a newspaper editor recently illustrating by comparison the telegraph-cable designed to unite Canada with the States, by being laid in the bed of the River St. Clair, from Detroit to the Canadian shore, says of it : "it is larger by considerable than the Atlantic submarine cable."

A man *concludes* a bargain, and he *resolves* on a certain course of action. A man also comes *to a conclusion* after having considered a matter. But there is a difference between coming to a conclusion and resolving. To do the former, merely implies that he has formed an opinion, to do the latter implies that he has determined on a course of action. So we understand it, and so the words are used in English literature. But it is becoming common in Canada to confound *conclude* and *resolve*, and to speak of conclusions when resolutions are intended. Thus :—"I *conclude* to go," is put for, "I have *resolved* or made up my mind to go ;" surely a very needless confusion of ideas or vocables.

A *territory* is defined by Webster to be "a tract of land belonging to, or under the dominion of a prince or state, lying at a distance from the parent country, or from the seat of government." It is also used for the *whole lands* belonging to any kingdom or state. On

this continent, it is often applied in its first signification, thus :—" the *territory* of Wisconsin," and indicates then, either all the lands of a state or nation, or certain distant or outlying possessions. *Region* and *district* again indicate a portion only of a kingdom, province, or territory. But a *district* may indicate a very minute portion of a state, county, or even of a city; whereas a *region* describes so wide an extent of country, as almost to be synonymous with that word. Beginning, then, with the latter, we say *district* means the smallest measure, *territory* a large measure, and *region* the largest of all. But in the States and Canada, the three words are often confounded; *territory* is put for *region*, and *region* for *district*, until neither word has any exact or specific meaning left. It is inevitable, indeed, in a new country, settled under peculiar circumstances, so different from those of the mother country, that new terms should be devised. Hence our Gores, Townships, Concessions, broken-fronts, water-lots, &c. But all of these are definite, universally understood with the same significance, and so contribute to the precision of language, instead of detracting from it, and as such, some of them at least, will be permanently incorporated into the English language.

People who speak English, say of a jury when it returns to court, and expresses its judgment, that " it *renders* its verdict," and this act is called " the *rendering* of a verdict," or technically " its finding." All this appears intelligible, and we are slow to imagine anything plainer. But people who, whatever their shortcomings, try to speak the language of Swift and Addison, are little aware of the progress of the age. With many among us, juries never *render* verdicts, but make *rendition* of them; and such, in lieu of speaking of *a finding* or *rendering*, refer to what they style *a rendition*, a mode of expression which, whatever it may be, is not English in such a connection. There is such a word as *rendition*, but it means *surrender* or *yielding possession*. it is a diplomatic, or law term, more than anything else. Let us apply the true meaning of the word to the action of a jury. Thus :—" the jury returned to court in the course of half-an-hour, and surrendered or yielded possession of their verdict." I submit that such bodies of men give, or express, but do not *surrender* opinions. Indeed, one would like to know how any man could surrender an opinion ? A man may make *rendition* of his property, bnt he only *expresses* his sentiments. As the men of Derry said, so say I, " no surrender." But the most absurd use of this abused word may be illustrated by its mode of introduction in a newspaper notice of a concert recently given in Toronto.

The writer seems to have been pleased with some tune, and he accordingly speaks of "the beauty of its *rendition*." Musical people do speak in a certain sense of "*rendering* tunes," but the author of this critique has the honour of originating the idea of a tune being capable of *rendition*. The unsophisticated reader would be sorely tempted to ask how in all the world could a man *surrender* a tune? Doing so implies a measure of coercion. But can a singer be forced to sing, or even, having done so, does he thereby surrender the tune? By force you may take the notes out of his hand, but how can you take them out of his throat?

In England it occasionally happens that great offenders are *hanged*, but in the States and Canada, criminals are never *hanged*; they are all *hung*. In England, beef is *hung*, gates are *hung*, and curtains are *hung*, but felons are *hanged;* in Canada, felons, beef, gates, and curtains, are all treated in the same way.

But our English is not only wayward and independent, it is also so exceedingly modest, that we are in danger, not only of altering our vernacular, but of forgetting how our bodies are constructed. If we know anything of English conversation or letters, we speedily find out, even if stone-blind, that British men and women have both arms and legs. But in Canada, a stranger who could not see, would find it difficult to discover much about our conformation. He would learn that both sexes had *limbs* of some sort, but from any information which our language would give, he could not tell whether their *limbs* were used to stand on or hold by.

Among British domestic fowls there are many styled *gallinaceous;* and among these are cocks and hens, male and female. But a blind naturalist could never fancy that we have the same distinctions in Canada. He would, indeed learn that we have hens; but he would wonder in vain what had become of their mates. That there existed an unknown creature called a *rooster*, he would early discover, but unless he made particular enquiry, he might return after a year's residence among us, thoroughly convinced that there were no cocks in the province. Still greater, perhaps, would be his surprise, on making the discovery, to learn that in using the old familiar English name for the hero of the barn-yard, he had been using a very immodest word. This sort of thing is preeminently disgusting, and speaks ill, not merely for the taste, but for the morals of those with whom such a refinement originated. In Canada, such a garment as trowsers is unknown. What do we wear? Pantaloons is the reply; or more familiarly *pants*, with the feminine elegancy *pantalets!*

But is this the fact? Certainly it is not. At least it has never been my fortune to meet with one in this country who wore them. Pantaloons are an article of dress, out of fashion for fifty years. In more familiar vernacular they were wont to be called skin-tights, and while answering a similar purpose, are very different from trowsers in their shape. The origin of such a misnomer is sufficiently obvious. Such prudish euphemisms are by no means peculiar to Canada or the States. They find their complete parallel in the English synonymes: *unmentionables* or *inexpressibles*, and the like familiar shiboleths of immodest prudery, which belong exclusively to no class or county, but are none the less to be avoided by all who would regulate their mode of thought and expression by purity and true refinement.

In England, good housewives and the lieges at large, are sometimes horrified by the apparition of a loathsome insect, yclept a *bug*. Gardeners also find creatures of the same *genus* on their plants, and zoologists are familiar with numerous varieties of them. But, however great the variety, and however diverse the habits of different *species*, few words associated with insect life are so universally avoided, or are, from certain associations, more revolting than this monosyllable. And yet, we hear people on this side of the Atlantic, who, to say the least of it, are quite as familiar with this insect-pest as those on the other,—applying this nauseous title to the beautiful firefly which makes our fields so glorious on a warm summer night. Canadians call it the "lightning-*bug*!" Here, we have, not simply an abuse of language, but a breach of good taste, which it might be thought no person of refinement could ever perpetrate As well might they dignify a vase of sweetly scented roses by making it share with the offensive and suffocating missile occasionally employed in naval warfare, the euphonious epithet of "stink-pot!" Moreover as this term *bug* is universally employed both in Canada and the States as a synonym for *insect*, the further result is a loss of precision, such as, in the commonest use of terms at home, discriminates at once between a fly, a beetle, and a grub. In England the term *fly* is also applied occasionally to a light vehicle, and it is on the same principle I presume that a four wheeled gig receives here the elegant name of *buggy!*

Turning again to another class of words; there is a curious disposition manifested among our manufacturers of improved English, to convert our regular into irregular verbs, for the sake of gaining what some modern grammarians have styled the strong preterite.

In England, when a swimmer makes his first leap, head foremost, into the water he is said to *dive*, and is spoken of as having *dived*, in accordance with the ordinary and regular construction of the verb. Not so however, is it with the modern refinements of our Canadian English. In referring to such a feat here, it would be said, not that he *dived*, but that he *dove*. Even Longfellow makes use of this form,—so harsh and unfamiliar to English ears,—in the musical measures of his " Hiawatha :—

> " Straight into the river Kwasind
> Plunged as if he were an otter,
> *Dove* as if he were a beaver," &c.

As we say drive, drove, driven, we may look for the completion of the verb *to dive*, on its new model, and find the next poet's hero having " *diven* as if he were a beaver" or any other amphibious native of the new world. Though as yet unsanctioned by such classic authority, the verb *to give* not unfrequently assumes among us the past form of *he guv*, *rose* becomes *ris*, *chid—chode*, *delved—dolve*, *helped—holp*, or *holped*, *swelled—swoll*, &c. Yet so lawless and systemless are the changes, that, along with such alterations, which might seem to aim at a universal creation of strong preterites, we have the process reversed, and *froze* becomes *freezed* or *friz*, *felt-feeled*, &c. That some of these are as yet mere vulgarisms is not to be denied, but when the older examples receive the sanction of the highest literary authorities we may reasonably dread that the adoption of the remainder is a mere question of time.

When an Englishman speaks at random or without sufficient authority, he *guesses*. When he expresses an opinion, he *thinks*. *Guess* and *think* are not synonymes, but refer to two opposite states of mind. Far otherwise is it in the neighbouring republic, and with too many here; for, with Americans and their imitators, *guess* and *think* have an identical signification. A "Clear-grit" *guesses* that the person beside him who does not spit on the floor, is a tory and a contemptible aristocrat, while a tobacco-moistening " Hoosier" *guesses*, and for like reasons, that a Boston merchant must be a federalist. Now if they only knew it, neither of these discerning and refined individuals *guesses* at all. Contrariwise. each feels confident in the matter pronounced upon. The general conduct of the persons of whom they thus judge, together with the subdued action of their salivary glands, has satisfied both that the political tendencies of the others must be the antithesis of their own. They are in *no uncertainty*, and a *guess* is impossible. The ordinary American use of this word justly

subjects its users to ridicule, unless the precision which our English tongue once boasted of is no longer a feature worth preserving.

But a volume might be written about the evils glanced at here. In closing this paper, therefore, I can only indicate a few more of the indigenous elegancies which are already meeting with such general acceptance, and thereby corrupting, not simply the speech of the Province, but such literature as we have. It cannot, we fear, be justly affirmed that such expressions as the following are so entirely confined to the vulgar and uneducated as to be undeserving of notice as an element likely to affect permanently the language of the Province:—

"Are you better to-day?" inquires Britannicus. "*Some*," replies Canadiensis. "Were there many people present?" asks B. "*quite* a number," answers C, meaning thereby "a number," for how can a number be otherwise than *quite a number?* B:—"Where did you go to-day?" C:—"*down town*," that is, he walked through, or in the city. B:—"are you going by this train?" C:—"yes, I'm just *on board*." B:—"where is your master?" C:—"the *boss* is out." B:—"How many horses have you?" C:—"a *span*," which word he substitutes for "a *pair*." B:—"what is that man's character?" C:—"he's a loafer," that is, in plain English, "a good for nothing fellow." B:—"how do you vote?" C:—"I go the Hincks *ticket*." B:—"has there been a committee meeting?" C:—"yes, they had a *caucus* last night." B:—"can that wheel revolve now?" C:—"yes, I guess it can do nothing else, for I've *fixed* it." B:—"did you mend my shoe." C:—"yes, I've *fixed* it." B:—"when will your sister be ready?" C:—Jane is just *fixing* her hair." B:—"what do you eat to venison?" C:—"jelly *fixings*." B:—"what have you done with your other horse?" C:—"I've *dickered* him." B:—"what kind of a speaker is W—?" C:—"a *stump-orator*." B:—"how did he get his present office?" C:—"by *chiselling*." B:—"is there much jobbing in the house?" C:—"no end of *log-rolling*." B:—"did he run away?" C:—"yes, he *sloped*," or "*he made tracks*." B:—"how do you feel to-day?" C:—I'm quite *sick*." B:—"sick! why don't you take something to settle your stomach?" C:—"my stomach isn't unsettled. Its my toe that aches!" &c.

Nor is it in solitary words or phrases alone that we are thus aiming at "gilding refined gold," in our improvements on the English language. So far has this process already been carried that it would not be difficult to construct whole sentences of our Canadian

vernacular which, to the home-bred ear, would stand nearly as much in need of translation, as an oration of one of the Huron or Chippeway Chiefs whom we have supplanted from their ancient hunting grounds on the shores of the great lakes. Let us take a brief example. A Canadian who has enjoyed the advantages of the American vocabulary will thus describe a very simple transaction:—"I traded my last yorker for a plug of honey dew, and got plaguy chiseled by a loafer whose boss had dickered his lot and betterments for notions to his store;" some of the words introduced here are genuine Americanisms, such as *betterments, i.e.* improvements on new lands; *lot*, or division of land; *town lots*, sites within the area designed for a village or town; *boss* (Dutch) the euphemism for the unpalatable word *master;* and *store*, the invariably term for a shop. Others again, such as *yorker:* a shilling york currency, or sixpence sterling, are no less genuinely Canadian; and the whole, will become intelligible for the first time to the inexperienced English ear when thus translated:—"I exchanged my last sixpence for a packet of tobacco, and got thoroughly cheated by a disreputable fellow whose employer had bartered a piece of improved land to obtain small wares for his shop."

These and a thousand other examples which might be produced, fully justify the use of the term "Canadian English," as expressive of a corrupt dialect growing up amongst our population, and gradually finding access to our periodical literature, until it threatens to produce a language as unlike our noble mother tongue as the negro patua, or the Chinese pidgeon English. That the English language is still open to additions no one can doubt, or that it assimilates to itself, when needful, even the racy vernacular of to-day, to enrich itself, where synonymes are wanting. Hence, whenever a single word supplies the place of what could only be formerly expressed by a sentence, — unless the word be singularily uneuphoneous,—the language gains by its adoption. But if *chiseling* only means *cheating;* and *log-rolling,—jobbing;* and *clearing out*, or *making tracks,—running away;* then most men of taste will have little hesitation in their choice between the oldfashioned English of Shakespeare, Milton, Swift, and Addison, and such modern *enrichments* of the old "well of English undefiled." Such words-of-all-work, again, as *some*, and *quite*, and *fix*, and *guess*, having already a precise and recognized acceptance in classical English, it is probable that good writers and educated speakers will still recognize them in such sense, and when they *fix* a wheel immovably, they will say they have fixed it; but

when they mend or repair the same wheel, they will find no inconvenience in using one of the latter terms as equally apt and less ambiguous. And so also when they make a *guess* at some fact beyond their certain knowledge they will say so; but when they speak of what they actually do know, they will state it as a fact, and not guess about it.

An amusing illustration of the manner in which such misuse of words can obscure the sense of their true meaning even in the minds of educated men, is furnished by a critical comment in the "Shakespear's Scholar," of Richard Grant White, A.M.,* on the following passage in "Richard III." Act IV, Scene IV:—

STANLEY. Richmond is on the seas.
K. RICHARD. There let him sink—and be the seas on him.
White livered runnagate;—what doth he there?
STANLEY. I know not, mighty sovereign, but by guess.
K. RICHARD. Well, as you guess?

A better illustration of the correct use of the word could no where be found. Stanley says he does not know, he only guesses; and the king replies; well tell me what your guess or suspicion is. But hear the American critic:—"If there be two words for the use of which, more than any others, our English cousins twit us, they are 'well,' as an interrogative exclamation, and 'guess.' Milton uses both, as Shakespear also frequently does, and exactly in the way in which they are used in America; and here we have them both in half a line. Like most of those words and phrases which it pleases John Bull to call Americanisms, they are English of the purest and best, which have lived here while they have died out in the mother country." To such "*English of the purest and best!*" are we fast hastening, if some check is not put on the present tendencies of our colloquial speech, and the style adopted in our periodical literature.

It may be assumed that enough has now been said to shew the truth of the complaint with which this paper began. How then is the evil to be remedied? One or two suggestions occur to me which may not seem unworthy of some attention, as means calculated to check in some degree this growing evil. The first is that, educated men in private stations should carefully guard against the errors indicated, and others germane to them, and use their influence to check them when introduced. The second is, that our common school teachers should not only do likewise, but should correct the children under their care, whenever they utter slang or corrupt English, not

* Shakespear's Scholar; being historical and critical studies of his text, characters and commentators, &c. By R. G. White, A.M. Appleton & Co., New York, 1854.

only in the school, but in the play-ground, and on the streets; and the third is that, our newspaper and other writers should abstain from the attempt to add new force to the English tongue by improving the language of Shakespeare, Bacon, Dryden, and Addison. It is true that these are antiquated names; and it may be that some among us rather know them by the hearing of the ear than the sight of their works; still, weak though it may seem, and—to cull once more, for the sake of illustration, one of the choicest phrases of Canadian letters,—"old fogyish" though it may appear, I cannot get rid of the impression, that those men understood English fully as well as any American or Canadian author, and that, though they never wrote slang, no one either on this side of the Atlantic, or on the other, has written, or is likely to write, either with augmented force, or greater clearness.

ON THE ORIGIN AND METAMORPHOSIS OF SOME SEDIMENTARY ROCKS.

BY T. STERRY HUNT,

OF THE GEOLOGICAL SURVEY OF CANADA.

The progress of Geological investigation has shown that many masses formerly regarded as primitive and even as hypogene rocks, belong to formations, which in other parts of their geographical distribution appear in the form of sedimentary strata, destitute of crystalline character, and distinguished by their organic remains as pertaining to various geological epochs. Thus the researches of Sir William Logan have shown conclusively that the serpentines, talcs, diallages and pyroxenites of the Green Mountains are portions of altered Silurian Strata, and I have already suggested that these rocks have been formed by the metamorphosis of certain beds of silicious and ferruginous dolomites and magnesites which occur in the Quebec division of the Hudson River Group, and are found in its unaltered portions interstratified with pure fossiliferous limestones, sandstones, and graptolitic shales.

Dolomites have, until recently, been regarded for the most part as altered rocks, and the mode of their formation is but little understood. When carbonated waters, containing lime and magnesia in solution, are

exposed to the air, the former base alone is at first deposited, and the magnesian carbonate is only separated by evaporation. When carbonate of soda is added in small quantities to a liquid, such as sea water, containing chlorides of these two bases, the precipitate formed in the cold consists chiefly of carbonate of lime, and the liquid, by evaporation, deposits a large quantity of carbonate of magnesia with a little lime, and then contains only chloride of magnesia (with soda salts) in solution. It is well known that the precipitate formed by carbonate of soda in a solution of chloride of magnesium is soluble in an excess of either of these salts. We have in Canada a great number of saline springs, which rise from Lower Silurian rocks, and appear to be formed by the mingling of the bittern-like waters, destitute of earthy carbonates, and derived from the lower limestones, with the carbonated alkaline waters of some of the associated strata. These saline springs, such as Plantagenet, St. Léon, and Sainte-Geneviève, deposit by evaporation, at a gentle heat, large quantities of earthy carbonates, of which the carbonate of magnesia forms from 50 to 95 per cent.; they sometimes contain but a trace of carbonate of lime. The spontaneous evaporation of basins of similar waters would give rise to the formation of dolomites or magnesites which would assume the form of detached or interrupted beds or lenticular masses among the pure limestones and other non-magnesian deposits of the region. Such are precisely the conditions in which the magnesian rocks occur in the Hudson River Group. Many of them may, however, be the result of a direct precipitation which may take place in deep sea water, from the infusion of alkaline carbonates.

Mingled as these magnesian deposits naturally are with sand and clay, we have in the silica, magnesia, lime, alumina, and oxide of iron of the sediment, the elements of serpentine, talc, pyroxene, hornblende and chlorite. For the production of these minerals it is necessary to dissolve the silica, and cause it to unite with the bases present, expelling the carbonic acid. The agent in this reaction has doubtless been an alkali. A solution of carbonate of soda at 212° F. will slowly dissolve silica, even in the form of quartz, and the silicate of soda thus formed, is at once decomposed at this temperature by the carbonates of lime, magnesia, or iron, with the production of a silicate of these bases, and the regeneration of the alkaline carbonate, which is then free to operate upon a new portion of silica. In this way a small amount of alkali may serve as the medium for the silicification of a large amount of carbonates. I have verified all these reactions by experiment, and have found that a silicate of magnesia is formed when quartz is boiled with carbonate of magnesia, and a solution of carbonate of soda.

A silicate of protoxide of iron, unalterable in the air, may be formed by an analogous process. The reactions of alumina, and of silicate of alumina under similar conditions have yet to be examined.

It appears to me that by this extension which I have given to the reaction between carbonate of lime and soluble glass, already pointed out by Kuhlmann, we have a key to the mode of formation of most of the silicates of the metamorphic stratified rocks. The subject will be found still farther developed in the forthcoming Report of Progress of the Geological Survey.

NOTES ON THE NATURAL HISTORY OF NEW ZEALAND.

BY S. P. STRATFORD, M.D., OF AUCKLAND, NEW ZEALAND.

Read before the Canadian Institute, 28th February, 1857.

Having been fortunate enough to secure a favorable opportunity for transmitting a package to Canada, I have availed myself of it to forward, for the Museum of the Canadian Institute, some specimens of the geological formations and objects of natural history belonging to this part of the world, which I hope may possess some interest for the members of the Institute.

Among the geological specimens will be found vesicular scoriæ, lava, volcanic ashes and cinders. These abound in almost all parts of New Zealand, and in the neighbourhood of Auckland are particularly marked. Auckland, indeed, is a spot especially favorable to the study of volcanic action, and I only regret that professional engagements prevent my paying such attention to the subject as I would wish. It may not, however, prove unacceptable, if I accompany the specimens with a few remarks upon the subject, or at least note, for my Canadian friends, some facts connected with the traces of volcanic action in this neighbourhood.

In the immediate vicinity of Auckland we have volcanic cones of various dimensions, from the height of a few feet to upwards of one thousand feet. They are grouped together in clusters, so that from the top of Mount Eden, two miles from this city, eighteen or twenty may be counted. It must not, however, be imagined, that the vol-

canoes in the immediate vicinity of Auckland are the highest. Tongeraro, an active volcano in the centre of the island, is extremely high, rising far above the level of the perpetual snow line. It is in almost continual action, and is surrounded by mountains with altitudes approaching its own, and which exhibit clear indications of a volcanic origin; indeed, the whole country shows that the volcanic influence is general, and I imagine that the incandescent material approaches the earth's surface in an unusual manner. Solfataras, or volcanic vents, are met with, and accompanying these, abundant exudations of sulphur, of nitrate of potash, &c. Hot springs and mineral waters abound; indeed, the hot springs of *Rotumakana*, at which the natives cook their food, and which, from their volume, are more like cataracts than springs, fall into Lake Tampo, and heat the waters of the lake for a considerable distance around. I do not doubt that these remarkable springs will hereafter become objects of no slight interest to the geologist.

Sulphur springs are numerous, and an efflorescence of sulphate of alumina is found spreading over extensive surfaces of the earth, while the volcanic fire, which I imagine to be the remains of an enormous lava current not yet cooled, is so near the surface that a red heat may be seen in the interior, through openings in the earth; indeed, it is said that the crust sometimes breaks through, and exposes a considerable extent of burning matter. Sometimes bogs or swamps of boiling water are met with, covered by a thin crust of earth. A short time since a Missionary travelling in this volcanic region of New Zealand, ventured to cross such a surface. He broke through into the scalding water, and had his extremities dreadfully injured. It would take a long time to investigate all that is novel and interesting in this part of the country, as it is covered by an interminable forest of great density, such as a tropical climate could alone equal. It is characterised by dense vegetation, and with an immense number of climbers and vegetable parasites of great and varied luxuriance.

Auckland is distant some 500 or 600 miles from the mountain region of New Zealand; and as I have not yet penetrated to that elevated district, I cannot speak of it from personal observation. But as the Waikatu river, which rises in Lake Tampo, takes a northerly direction for 300 miles, emptying itself into the sea on the west coast of the Island, and as settlements have already been commenced along its shores, which are in direct connection with Auckland, the time is not far distant when a visit to the highlands of New Zealand will be

mainly included in a pleasure trip up the Waikatu river in a steamer. The whole valley of the Waikatu is of the most luxuriant description, abounding in excellent pasture lands; admirably adapted for grazing, and holding out many inducements to the agricultural settler.

As I have before mentioned, some eighteen or twenty volcanic cones or craters of eruption may be counted within a few miles of Auckland. Taking Mount Eden as an example; it is about 800 feet high, with a crater 300 feet deep and from 400 to 500 feet wide. The upper part consists of very light ashes, its lip is very uneven, while hillocks of ashes may be seen at different points around it. The unevenness of the lip of the crater would seem to be caused by the influence of the wind, the deposits occurring on the points towards which the wind generally blows. In some instances it would appear to depend on the sudden cooling and falling in of the lava current, as I find that the depression of the lip is often immediately over the direction which the lava took when it forced its way through the sides of the crater.

Judging solely by their external appearance, some of these cones appear to be only mounds of volcanic ashes, being flat or nearly so on the surface, but as they are distant from any other rent, and surrounded by lava and other indications of volcanic action, their true origin cannot be doubted. In some cases the craters are filled with water, forming beautiful little lakes.

I find that the lava currents of Mount Eden have taken for the most part a N. E. or N. W. direction; when they forced their way through the ashes they ran down the sides and spread themselves over the country, leaving at these spots a marked depression of the crater lip. I think I can distinguish several distinct layers of lava, and one has evidently preceded the other by a considerable period; thus the hard stony matter may be observed to have exuded in a certain direction, ending in some instances in a rounded surface, in a manner that—to use a homely simile—reminds one of hasty pudding which has almost ceased to run; a surface that has begun to cool and solidify, but is yet pushed forward by the fluid beneath. The more general appearance of the lava currents, however, is a surface broken up, cracked and split in all directions, the leaves are extreme-uneven, and we find rugged surfaces of rock piled on each other in extreme confusion. The lavas about Mount Eden are of a blueish gray colour like trap, as will be observed in a specimen which I have sent. At the extremity of the lava current there is generally

found a stream of water, in which most commonly splendid water-cresses abound, along with many beautiful aquatic plants which remain green throughout the year. Among them may be mentioned the celebrated Rapo or *Typha augustifolia*, which is used by the natives and by new settlers as a convenient building material. They form the walls and roofs of their houses of bunches of it, and tie them together with the Mangi-mangi or climbing fern, *Lygedium articulatum*. Very warm and convenient houses are thus constructed, impervious to rain or wind. I have seen the inside lined with cotton, and then covered with figured paper; and thus finished it is exceedingly comfortable, and makes a very respectable appearance.

The New Zealand flax, *Phormium tenax*, grows on the margins of the streams, its leaves often measuring six feet in height, surmounted by the flowers on an elevated foot stalk. Its dark green leaves and its tuft-like appearance render it a most graceful object. Again the observer will meet with a cluster of the New Zealand fern tree? *Cyathea medullaris*, the noble palm tree, *Areca sapida*, or the curious grass tree, surmounted by tall luxuriant ferns. These present a pleasant picture, a combination of grace and beauty not to be surpassed, I believe, in any other part of the world.

In the layers of volcanic matter I could easily count three successive streams of lava which are now piled one above the other in wild confusion. These eruptions tended towards the N. E. Towards the N. W. the expanse of erupted matter is more extended, rugged and broken, but does not appear to be the result of so many distinct volcanic actions. If the course of the lava current is traced, it sometimes appears to dip, or penetrate the earth for certain distances, again appearing upon the surface. In some instances a smooth dome like surface of the lava will be met with which has cooled without fracture. This presents unmistakeable evidence upon its surface of having flowed slowly, or cooled as it flowed, for marks like wrinkles may be observed, on percussion it sounds hollow, and it has plainly been a spot where the fluid lava was arrested for a short period and its surface cooled, while the internal fluid lava continued its course to the lower levels of the plain. At other points in the same current it may be observed that these domes have given way, and now form deep, rugged and dangerous cavities into which animals sometimes fall, and can seldom get out without assistance, although they may penetrate to some considerable distance along the course of the current. Some of these cavities contain water, and in many instances they are almost concealed by the thick foliage and beautiful ever-

greens which grow from them. In many examples where the lava current leaves the crater and passes into the open air, cavities of this description may be observed, and indeed the adventurous explorer may pass for miles underground along these *caves* as they are called. Most of such caves appear to have been the retreat of vanquished tribes, as human bones are often found in them in very great quantities.

At other points of the lava current, may be found as it were miniature volcanoes--points at which the lava current has been detained while still fluid, and where the confined gases have exploded with great violence, blowing up the lava as out of a crater, and spreading the matter in pieces over the surrounding surface. I conceive that the gases may have been produced, in part at least, by the decomposition of water which the lava met with in its course under the surface of the earth.

Around the mountain are to be found innumerable loose stones, some of enormous size, which have been ejected from the crater. These have often passed to a great distance, and are in some directions thickly covered with sand. A person unacquainted with this fact, would almost despair of being able to employ the land for agricultural purposes, but the stones are only on the surface, showing that the present soil existed before they were ejected. They are used for making permanent fences. Some of them consist of solid lava, others of vesicular scoriæ, most of them are round and appear to have assumed this shape from having been projected to a great height into the air while still in a fluid or semi-fluid condition.

The rough angular surface of the lava, which is fractured into deep chasms presenting abrupt angles, and looking to the eye as a chaotic mass, heaped up in wild confusion, instead of the even surface it presented while still liquid, is evidently owing to the changes of temperature which it has undergone, and the contraction of the particles consequent thereon. The enormous cracks and disjointed fractures are evidence of the intense heat which once pervaded the molten mass, and now make it difficult to believe that it ever presented an even surface..

I send you some of the earths which abound in the neighbourhood, convinced that they have all issued from the volcano in the form of mud or ashes, and as the constituents, and the peculiar condition of such may involve questions interesting to the geologist, I thought you would probably be pleased to receive them, and might cause them to be analysed. I am fully convinced that not one of the layers of

earth which I find about Auckland and its neighbourhood is of sedimentary origin, and I believe a chemical analysis will clearly show this fact.

The peculiar shape and conformation of the land also tends to prove the same, the lay of the land generally indicates spurs or buttresses, which seem to start from the volcano, and extend as rays from a centre, the base of the ray is to the mountain, and it tapers off until it is lost, and in most instances it takes such a shape as might have been assumed by a thick fluid mass flowing down the hill.

The vast number of volcanic rents in this neighbourhood, which have all in their time poured out liquid mud and fluid lava, serve to produce great confusion and complexity in the arrangement of these formations, but by care and perseverance we can generally trace the course of each current of mud. In some of them we find the round masses of vesicular scoria which have been incorporated in the mud and hurried down into the plain below.

In carefully analysing these avalanches of mud it is seen that each has its precise location according to the period of volcanic action. I believe that their difference depends in a great degree upon the depth from which the matter has come. If near the surface it possesses certain characters, but it changes as the combustion penetrates deeper into the central mass of the earth, and lastly fluid lava is forced out upon the surface. We are ignorant of many of the laws which regulate volcanic action, and I am certain that a noble field is open in this neighbourhood for that study, for we have rudimentary volcanoes in all stages of development until we arrive at Pongauro, which presents evidences of great age and continual activity.

The question which is naturally asked is, at what period were the volcanoes about Auckland in active operation. No reliable record has been preserved of that period by the inhabitants; the natives have a kind of tradition that Rangatoto, the highest of the volcanic vents about Auckland, was in operation during the last century; the name itself would seem to confirm this statement, as when translated it signifies "Blood-red sky," a common effect of the eruption of a volcano when seen by night. The discovery of lignite, evidently the remains of ferns and trees now growing in New Zealand, in all directions and under layers of great thickness, would lead to the conclusion that the process of formation had been recent; among the layers of earth I have sent, you will find lignite taken at a great depth, viz., from a well 50 feet deep. I was enabled easily to distinguish among the earth, fern roots and partially decomposed wood, besides which pieces of Kauri

gum were found, showing that not only had ferns grown there but also the noble pine—Dammara Australis. Although covered with a great volume of clay, these remains were enveloped in fine volcanic ashes, showing that such had preceded the eruption of mud. From another well equally deep, near the barracks, I have seen lignite brought up, but this was covered with volcanic cinders several feet thick, besides the clay I have before mentioned. Indeed all the evidence appears to be favorable to the idea of recent eruptions from these volcanic vents, and should it happen that several of them go into operation simultaneously, the inhabitants of Auckland will witness a terrific spectacle. In all probability full notice of the event will be given, in the form of earthquakes and subterranean noises, none of which have been noticed hitherto in sufficient intensity to excite any fear, at least during the last sixteen years.

I have mentioned that there are numerous pieces of rock lying about, but these are plainly scoriæ and derived from volcanoes in the immediate vicinity, not the water worn boulders seen so plentifully in Canada. Our latitude is about 36° south, but I have not seen any evidence of boulders conveyed by ice, and should their total absence be confirmed, I should regard it as a strong evidence of the recent formation of land in these parts.

In the strata formed in the Island of Rangatoto, and in various other parts of our neighbourhood, and which in some cases attain a considerable elevation, and have evidently been exposed to disturbing agencies, many shells and vegetable remains may be discovered. These shells are such as can be found on the shores at present in a living state, and the plants are such as still grow on the island.

These plants and shells have evidently been covered by eruptions of liquid mud or ashes. Cracks have been formed during the drying, and these are sometimes filled with carbonate or oxide of iron.

Such facts prove very clearly that the Islands of New Zealand are of quite a new formation, which is still further shown by the paucity in the variety of the vegetation, the almost total absence of animals, and the complete freedom from venomous reptiles. Although there are scarcely any native plants and animals, yet almost every species of plant and animal thrives well. The English pheasant and the guinea fowl has become wild, and the hogs left by Cook are now spread over the whole island.

The climate is most equable; during my twelve months residence, I have scarcely seen six really wet days, I have seen ice and the temperature has been as high as 75°, but these are the extremes, and occur very rarely.

The natives are a fine race of men, and very apt at learning. They soon become good navigators ; some own large schooners and sail them themselves ; their canoes are excellently made and will stand any sea. They own many mills and cultivate the land largely, the women doing most of the labor. Their character is kind and hospitable, and in war they are by no means to be despised. Their fortifications exhibit considerable ingenuity.

Among the specimens of natural curiosities will be found the vegetable caterpillar—the *Sphœria sicudes* or *Robertia* as it is called. It is very abundant in New Zealand, especially upon the west coasts, where it is said that tons might be collected. I am in hopes it may become an article of trade with China, where the fungus is prized very highly and is used as a medicine. The Sphœria Robertia although bearing much resemblance to a caterpillar is evidently a plant, the mode of its production is said to depend upon the growth of a sporule of the fungus germinating within the body of the animal while yet alive. Aware of the disease, the caterpillar seeks the shelter of the Rata tree, and lays itself up to die under it, in due season the fungus shoots out its stem, flowers, seeds, and dies. From the specimen I have sent, abundant evidence of its fungus nature will be manifest. The butterfly that produces this caterpillar is said, by an intelligent friend from Hohinaga, to be the Hepialus Sericeus ; when the eggs are hatched, the caterpilar seeks the Kahikaton tree, bores into it to a great depth, and then covers its hole over with bark and web, so as to hide itself from the depredations of the Waita, a species of flea nearly as large as a mouse. I shall try my best to obtain correct information upon this matter with a view to communicate it to the Institute when I write again.

Along with the other specimens now forwarded, illustrative of the Natural History of New Zealand, I have sent a Hippocampus which was taken upon the little Barras island in the Gulph of Hourica, not far from Auckland.

REVIEWS.

Catalogue of Human Crania in the Collection of the Academy of Natural Sciences of Philadelphia ; based upon the third edition of Dr. Morton's "Catalogue of Skulls," &c. By J. Aitken Meigs, M.D., Librarian of the Academy of Natural Sciences of Philadelphia, &c. Philadelphia : J. B. Lippincott & Co., 1857.

No purely scientific American work has more firmly, though slowly, established its claims to a permanent place among the valued contribu-

tions to the materials of progressive science, in relation to some of the most important questions of our day, than the *Crania Americana*, the work of the late Dr. Samuel George Morton, of Philadelphia. Valuable, however, as it is, it cannot detract from the merit of its author's zealous and persevering labors to say, that it has furnished materials destined to lead others to still more comprehensive and exact results than any he arrived at. Nor did it complete his labors; he was a worker until the last, and every production of his pen has a further value in relation to his chief contribution to ethnological science. Such is felt, in an especial manner, to be the case, in reference to the catalogue originally prepared by himself, and now carefully edited and enlarged so as to embrace the greatly augmented collection of skulls formed originally by its author. It furnishes many details, indispensable as addenda to the *Crania Americana*. Without it, for example, all the additional examples included in the "Table of Anatomical Measurements," in that work, are scarcely available for the general purposes of analysis and comparison. Of these it supplies, in relation to nearly all of them, the requisite facts as to sex, age, special characteristics, &c., most desirable to be ascertained. Had its careful and pains-taking editor, Dr. Meigs, added, in the case of those not included in the *Crania Americana*, some, at least, of the most essential measurements, such as the longitudinal, vertical and parietal diameters, and the horizontal circumference, he would have greatly increased its usefulness. In lieu of this he has followed Dr. Morton in giving the *facial angle* and the *internal capacity* of each; but to neither of these measurements can we attach much value. Beyond such aid as it gives in testing the prognathous character of the superior maxilla, the facial angle is valueless. It rarely takes into account the forehead, while it is liable to be greatly affected by comparatively insignificant variations in the maxilla and position of the teeth, and is so indefinite and uncertain that two accurate and experienced observers will frequently vary considerably in their measurements, executed with the same facial goniometer. So, also, the *internal capacity*, given as it is in this catalogue, without reference to the attempts made by Dr. Morton to discriminate between the comparative occipital, parietal, coronal, and frontal developments, can at most be available only for some general averages. In the great majority of the averages which Morton and later writers have struck, the number of examples is greatly too small; while, to do justice to the actual value of comparative cranial and cerebral capacity, the relative size of skull and skeleton must needs be ascertained, otherwise a small-headed and small-brained giant, with intellectual

powers considerably below the average, may compare advantageously in cerebral capacity with some Milton or Newton.

The Catalogue of Crania, as now edited by the intelligent librarian of the Academy of Natural Sciences of Philadelphia, is extensively illustrated with wood-cuts, executed for the various works to which it supplies an important supplement. In some respects it is expressly set forth in emendation of measurements and other data furnished in the *Crania Americana;* and for all facts in relation to the important cranial collection which supplied the materials for that great work, it is—as the latest authority, embodying the final corrections of its author, as well as the careful additions of the editor of this catalogue, —indispensable to the American ethnologist. The rapid progress which the Philadelphian collection of human crania is now making is shewn by the very discrepancies between the earlier and later sheets of the catalogue. On page 50 an addition of seven Esquimaux and two Loo Chooan skulls is recorded, the gift of Dr. B. Vreeland, U.S.N., who procured the former at Godhavn, Disco Island, on the coast of Greenland. Again, on page 102, the skull of an idiotic negress, of remarkable character, is noted as a still later addition; and the whole collection, at the date of the final correction of the catalogue, during the present summer, embraces a total of 1,045 human skulls, including specimens from so many localities, and selected with reference to such remarkable peculiarities of site, form, mode of sepulture, and the like, as to constitute it one of the most interesting and valuable series of ethnographic materials for study either in the New or the Old World.

D. W.

Progress of Mathematical and Physical Science. The Encyclopædia Britannica. Eighth edition. Dissertation Sixth: exhibiting a general view of the progress of Mathematics and Physical Science, principally from 1775 *to* 1850. By James David Forbes, D.C.L., F.R.S., Sec. R. S. E., Professor of Natural Philosophy in the University of Edinburgh, and Corresponding Member of the Institute of France. Edinburgh: Adam and Charles Black, 1856.

There are few undertakings which involve more formidable difficulties and require higher intellectual qualifications than the attempt to present, in a manner at once popularly intelligible and scientifically exact, the history of the progress of philosophy through any epoch.

For, in the first place, to write the history of any particular branch, the historian must have himself thoroughly mastered it; no mere dilettante or second-hand knowledge will save him from error on the one hand, or plagiarism on the other: however difficult or complicated the process by which an idea has been developed or result arrived at, it is essential that he go through it in all its details before he can venture to deviate from the form of words in which his predecessors or the author himself may have presented it. He is conscious also that his performance must bear the criticism of those who have made that department their especial study, and his knowledge is thus to be guaged by the standard, not of the average, but of the highest. When we consider the vast range and variety of direction, in which modern philosophy is sweeping, this requirement assumes alarming proportions, and, if to it we superadd the further difficulty of expressing scientific results in such language that he who runs may read—of stating in familiar words what is perhaps hard enough to understand in its proper technical form, we can hardly wonder that so few attempts have been made at thus writing the histories of even the separate physical sciences—much less that of the whole of them—and that scarcely any have been successful.

If the universal suffrage of the British scientific world had been taken, we believe it would have unanimously pointed out Professor Forbes of Edinburgh, as the man of all others (excepting only the illustrious author of the "History of the Inductive Sciences") most eminently fitted for the task, and the Dissertation, above cited, would have been a triumphant confirmation of their vote. Holding a prominent position in his University, and distinguished for original research in some special departments, Professor Forbes has been long known for one of the very few who have kept up their knowledge to the level of the general advance of philosophy throughout its whole extent, so far as may be done within the limits of human life and power. The work before us is in every respect worthy of his reputation, and we should find it hard to express our opinion of it in terms of praise which would not appear extravagant to persons whose perception of the excellence of the performance is not enhanced by a full appreciation of its difficulty. Regarding the work in its strictly scientific aspect, it becomes a reviewer to speak with diffidence, nor do we affect to be able to criticise all that is set down: we would only say, that in the departments with which we are most familiar, we have tracked our author minutely and rigorously, and that we have detected no inaccuracy of statement, no ambiguity of phrase by which a difficulty might be conveniently slurred over, none of those little slips which so often in "popular"

works enable the adept at once to say, "this man does not understand what he is writing:" all is exact, full, and genial as if the author enjoyed what he is describing; everywhere the subject is treated up to its very latest stage, nor have we noted a single omission of importance. On debatable points, whether of principle or history, its almost judicial clearness and impartiality are admirable, and even where we sometimes dissent from our author's opinion or decision, we have no fault to find with the manner of stating the case. In a literary point of view also, the work is excellently performed; the style is at once vigorous and elegant, reminding us of Herschel and Arago in their best efforts, and sometimes rising into eloquence as welcome as unexpected; while for deep and exhaustive reflection, and acute and happy generalisation, it abounds in passages which make it on the whole one of the most instructive as well as delightful books we have ever read. We suppose we ought to feel shame in confessing to the hope that some dishonest publisher on this side the Atlantic will reproduce it as soon as possible, for although it is "supplied to subscribers *gratis*," that is small comfort to those whose pockets are not deep enough for that whole Encyclopædia Britannica, and whose inclinations are decided for having the pennyworth of bread without the sack.

The range of period over which this dissertation extends, is somewhat limited, including only the last preceding three quarters of a century; this selection having been determined, as Professor Forbes informs us, by the fact of the previous ground having been already occupied in the Encyclopædia by the dissertations of Playfair and Sir J. Leslie. We think this is a matter to be regretted, for we cannot endorse the laudation which Professor Forbes somewhat ostentatiously bestows on his predecessors' productions. That of Sir John Leslie is often inaccurate, not seldom unjust, and, viewed by the light of modern science, altogether incomplete: and if the same objections cannot be urged against that of Playfair, still it is encumbered by masses of heavy technicalities which he has attempted to popularise, but has only succeeded in rendering tedious for the *savan* and mostly unintelligible to the general reader. We sincerely wish that the publishers had cancelled these ineffective essays and induced Professor Forbes to re-write the history of that most important epoch which includes Galileo, Kepler and Newton. The following is the programme which Professor Forbes has set out to be performed, so condensed and yet so lucid that we have not the heart to abridge it, long as it is for our space.

I have adopted the period from about the year 1775 to 1850 as the general limit of my review. We may imagine this period, of three quarters of a century

preceding the present time, to be divided into three lesser intervals of 25 years each, which have also some peculiar features of their own.

From 1775 to 1800, many branches of science still continued in the comparatively inert state which characterised a great part of the eighteenth century. There were, however, two or three notable exceptions. One was the continued successful solution of the outstanding difficulties of the theory of gravity applied to the moon and planets, a task in which the continental mathematicians had no rivals or even coadjutors on this side of the channel; another was the foundation of sidereal astronomy; and the last was the commencement of a system of chemical philosophy based on new and important experiments, and including the laws of heat in combination with matter, which at that period very naturally ranged themselves within the province of the chemist. I do not, of course, mean to affirm that other branches of science were not cultivated with success within the exact period of which we speak. Electricity, for instance, first statical, afterwards that of the pile, had a share in the discoveries and speculations of the time. But these were rather the extension of what had been previously thought of, or the first dawn of future important results, whose development fills a large space in the succeeding story.........

The first quarter of the present century attained a higher and more universal celebrity. Scarcely a branch of physical science but received important and even capital additions. Physical astronomy indeed no longer filled so large a space in the page of discovery, simply because the exhaustive labors of the geometers of the former period had brought it to a stage of perfection nearly co-ordinate with the means of observation, and because, by the publication of the *Mécanique Céleste*, Laplace had rendered available and precise the masses of scattered research accumulated by the labors of a century since the close of Newton's career of discovery. It was in some sense a new book of "Principia,"—not, indeed, the work of one, but of many; nor of a few years, but of two generations at least. Still there it was, a great monument of successful toil, which, like its prototype, was for many years to be studied, even by minds of the highest order, rather than to be enlarged.

But the other branches of natural philosophy were now to make a stride, such as perhaps no preceding time had witnessed. The science of optics was speedily expanded almost two-fold, both in its facts and in its doctrines. Galvanic electricity disclosed a series of phenomena not less brilliant and unexpected in themselves, than important from the new light thus thrown on the still dawning science of chemistry, and from the power of the tool which they placed in the hands of philosophers. Before the first quarter of the present century closed, the important and long-suspected connection between electricity and magnetism was revealed, and its immediate consequences had been traced out with almost unparallelled ingenuity and expedition. The basis of the science of radiant heat, slightly anticipated by the philosophers of the eighteenth and even the seventeenth centuries, was finally laid in a distinct form, assigning to the agent, *heat*, an independent position dissociated from grosser matter, such as *light* had long enjoyed Astronomy, though enriched on the very first night of the new century by the discovery of a small planet, the herald of so many more of the same class, made perhaps less signal progress; but chemistry, besides the aid it received from the invention of the pile, had a triumph peculiarly its own in the addition of the comprehensive doctrine of definite-proportions, destined to throw at some later time a

steady light on the vexed question of the constitution of matter. The great number of scientific names of the first order of merit concerned in these numerous discoveries marks the extraordinary fertility of the period.........

Of the twenty-five years just elapsed, it is not so easy to speak with precision. The voice of criticism may be fairly uttered with that reserve which every one must feel in speaking of his immediate contemporaries. Yet it may perhaps be stated without just cause either of offence or regret, that it has not on the whole been characterised by the full maturity of so many commanding minds. Of the great discoverers of the former period, several survived and continued their efficient labors during no small portion of the latter ; and a few happily still remain to claim the respect and veneration of their disciples and successors. But the vast steps so recently made in optics, in electricity, in magnetism, in thermotics, and in chemical principles, tended of necessity to call forth such an amount of laborious detail in the defining and connecting of facts and laws, and the deduction of the theories started to explain them, as seemed to render fresh and striking originality somewhat hopeless, whilst they occasioned a vast amount of useful employment to minds of every order of talent. The undulatory theory of light, nobly blocked out by the massive labors of Young and Fresnel, has afforded still unexhausted material to the mathematician on the one hand, and to the experimentalist on the other ; and ably have they fulfilled the double task, adding at the same time discoveries whose importance and difficulty would have made them still more prominent, had they not been the legitimate consequences of a still greater discovery already in our possession. Nearly the same might have been said for the sciences of electricity, electro-magnetism, and electro-chemistry, had not the comparative newness of the whole doctrine of these sciences, and the suddenness of their first rise, and, perhaps, still more, the appearance of a philosopher of the very highest merit, Mr. Faraday, who fortunately attached himself to this special department, made the last thirty years an almost unbroken period of discovery. Radiant heat, too, has been successfully advanced by labors comparable perhaps to those which marked its first rise as a science, and some other topics connected with heat have risen into great and practical consequence. Astronomy has been prosecuted with a systematic assiduity and success, especially at the British and Russian national observatories, which yields to that of no former period, whilst physical astronomy has been cultivated by methods of still improved analysis, and has achieved one triumph which France need not grudge to England, nor England to France,—so signal as to be placed by common consent in a position superior to any since the first publication of the theory of gravitation, more than a century and a half before. This was the prediction of the position in space of a planet whose existence was unknown except by the disturbance which it produced in the movements of another. Terrestrial magnetism has, for the first time, aspired to the rank of an exact science. In an illustrious philosopher of Germany, it has found its Kepler ; and the combination of national efforts in collecting reliable data from the remotest corners of the globe is characteristic of the practical energy of the age. Pure chemistry has been cultivated with extraordinary assiduity ; but though some general principles have emerged, none are comparable, from their importance, to the discovery of Dalton.........

It seems to me impossible to exclude from a review, however slight, of contemporary progress in the exact sciences, the advances which have accrued to them, both directly and, as it were, reflexively, by the astonishing progress of the me-

chanical arts. The causes, indeed, which called them forth are somewhat different from those which are active in more abstract, though scarcely more difficult studies. Increasing national wealth, numbers, and enterprise, are stimulants unlike the laurels, or even the golden medals of academies, and the quiet applause of a few studious men. But the result is not less real, and the advance of knowledge scarcely more indirect. The master-pieces of civil engineering,—the steam engine, the locomotive engine, and the tubular bridge,—are only experiments on the powers of nature on a gigantic scale, and are not to be compassed without inductive skill as remarkable and as truly philosophic as any effort which the man of science exerts, save only the origination of great theories, of which one or two in a hundred years may be considered a liberal allowance. Whilst then we claim for Watt a place amongst the eminent contributors to the progress of science in the eighteenth century, we must reserve a similar one for the Stephensons and Brunels of the present: and, whilst we are proud of the changes wrought by the increase of knowledge during the last twenty-five years on the face of society, we must recollect that these very changes, and the inventions which have occasioned them, have stamped perhaps the most characteristic feature—its intense practicalness—on the science itself of the same period.

It may be doubted whether the above does full justice to the period last mentioned, that in which we are now working. Judging by the history of the past, it is dangerous, perhaps presumptuous, to decide on the real value of labors which we view only in progress, or to estimate the magnitudes of intellectual characters when our very proximity to them confuses the judgment. The Principia was for years a sealed book to most of Newton's contemporaries, and few fellows of the Royal Society recognised in their unpretending secretary, Dr. Thomas Young, the man whom the lapse of a quarter of a century would proclaim the worthy inheritor of Newton's crown. So it may be, that we do not yet seize the full importance of such investigations as those of Oersted and Thomson; that we do not foresee the results to which such principles as Joule's Mechanical Equivalence of Heat may lead, or that we fail to observe the significance of those obscure utterances of Faraday in the midst of the brilliant discoveries for which we gladly applaud him. Still more do we think Professor Forbes has underrated our progress in pure mathematics—further on he writes: "No new calculus or great general method in analysis has resulted from these persevering labors, whether of British or foreign mathematicians, but an increased facility and power of applying the existing resources of mathematics to the solution of large classes of problems, previously intractable, or resolved only indirectly or by approximation."

Now we think that the method which is known by the imperfect title of the "separation of symbols," constitutes a really great and distinct step in analysis, not so much on account of what has been achieved by it directly, but in that it has led to a reconsideration of

the base on which our laws of symbolical reasoning are founded, and thence to a total reconstruction of the whole system of abstract analysis. Pushed in various directions, it has resulted in a new geometry, through the quaternions of Sir William Hamilton; in a new and effective method of solving differential equations, in the hands of Professor Boole; and, still more strangely, in an application of analysis, by the same gentleman, to the formal laws of thought; while several different systems, suited to attacking particular physical problems, have been proposed by various analysts. So many and varied are the ways in which this most fertile principle appears capable of development, that at present the difficulty seems to consist in discovering which will be best to choose. It is perhaps not too much to say, that here the differential calculus has at length generated a successor more powerful than itself, and which will ultimately absorb it. Nor should we forget our acknowledgments to the late Duncan Gregory, who was, if not precisely the inventor, certainly the first to perceive the importance of this method. We venture also to think that Professor Forbes has done scant justice to the progress of analytical geometry; the school, of which Plücker may be considered the founder, constitutes as great an advance upon the geometry of Descartes as his was upon that of the ancients.

That this epoch has not been distinguished "by the full maturity of so many commanding minds" is compensated, and partly accounted for, by the very large increase in the number of cultivators of science. Contrasted with that dreary period in British science which intervened between the death of Newton and the rise of that illustrious band of which Sir J. Herschel may be taken as the type,* the present day presents itself under a most hopeful aspect; where we can count one British name that emerges above the level for that period, we may count a dozen now, and if their elevation appear less, it may be because the level has risen. In great part this is due to the exertions of those illustrious men above spoken of, whose claim is not only to have done so much themselves, but to have produced a generation worthy to succeed them, and whose glories they justly share; partly also is it due to the improvement in our national seminaries, and the early introduction in them of scientific training, and also partly to the increased demand for scientific qualifications by the advance of engineering and the kindred arts; but we would fain believe that there is also a real improvement in the average mathematical faculty of the age, and that

* Herschel, Airy, Peacock, Whewell, Babbage, Lubbock.

the powers as well as the thoughts of men are "widened with the process of the suns."

Although this dissertation is headed "A General View of Mathematical and Physical Science," into one important branch thereof, namely, the abstract part, or pure mathematics, Professor Forbes has declined to enter. He says—

The mechanical and experimental sciences alone constitute a body of knowledge so large that it is a responsibility sufficient for one person to attempt to grasp them all, and to set forth in order the steps of progress and improvement which have been so rapid and even so startling. Since some of these have scarcely as yet been historically digested, and the broad features of contemporary discovery have not been gradually separated by the judgment of an impartial posterity from those slighter though praiseworthy details, which lapse of time and advance of knowledge will throw into the shadows of distance,—this most laborious task falls principally upon the reviewer. The length and breadth of the subject of natural philosophy, and the cumbrous and scattered depositories of knowledge in which its records must be sought, combine to render not only the undertaking an arduous one, but the result of it a good deal more bulky than might be desired, or than was easily possible, in dealing with the glorious, but compact, history of Newton's age. It might be compared to the difference between writing a history of the Jews or Romans and that of the whole of modern Europe.

The mere magnitude of the undertaking, then, might well excuse me from entering upon the cognate, but exceedingly distinct, subjects of the logic of inductive discovery and the progress of the pure mathematics. But an equally sound reason might be found in my consciousness of inadequacy to undertake, whatever had been the dimensions of my work, a threefold scheme of such magnitude and difficulty. I do not think that any one person could be found to treat the whole as it ought to be treated, and I am certain that I am not that person.

Against such a plea, so urged, nothing can be said, yet it is impossible to help regretting that it should be so. It is true that analysis must always always be subordinate to philosophy, and its very nature is dictated by the requirements of its application to physics; true also that a physical problem has sometimes suggested the general method in analysis which includes its solution as a particular case, and the practical value of a process is proportional to the number and importance of the problems to which it applies; yet we should remember that every epoch of great physical discovery has been immediately preceded by some grand extension of analysis, and that philosophy has too often long lain helpless till the analyst furnished her with the means of moving. Without the algebra of Descartes and Newton's method of series, Newton's Mechanics would have been barren of consequences, and without the integral calculus modern science would be reduced to a skeleton. Just as the immense development of our engineering and commercial enterprise was due to the invention of the slide-rest and the improvements of machinery consequent on this; just

as every enlargement of the domain of experimental discovery may be traced to some refinement of instruments or modes of observing; so has the progress of physical science been related to that of analytical. At the present time the two appear to have, unhappily, somewhat parted company; analysis is going its own way without seeming to heed its companion, and philosophy is dragging heavily from the desertion: or, to quit metaphor, most of our sciences have now reached that point where the problems pressing for solution involve no doubt or difficulty as to the principles to be employed, but are irreducible simply from the enormous difficulty and complication of the analytical processes which at present are at our command. Whether the deadlock is to be got over by the laborious calculations of algorithms—such as tabulating the values of numerous definite integrals—or whether our known methods are to give rise to a new one, which shall at once include and supersede them—who can tell?

Apart from its rendering the history incomplete, Professor Forbes's determination is the more to be regretted from the biographical form which he has adopted, as an apparent injustice arises to individuals whose analytical labors (apart from merit on their own abstract ground) should claim, though indirectly, a share in the triumphs of science. The man who invents a theorem may be, even by its practical outcome, more praiseworthy than he who has made a successful experiment or even determined a natural law.

In filling in the outline which we have already quoted, Professor Forbes has had before him the "History of the Inductive Sciences," and the "Kosmos," works of which praise would be an impertinence; he has, however, wisely evaded coming into competition with these by the plan he has adopted of connecting the history of each science with the biographies of those who contributed to its rise and progress. Whatever is thus lost in the continuity of the history is atoned for by the human interest with which it becomes invested. Some one has remarked that the life of a man of science rarely presents any incidents of interest apart from his science; reciprocally, it is here shewn that the history of science can only be thoroughly understood by aid of the lives of those who have spent themselves in her service. In addition to the physical sciences, Professor Forbes has included the mechanical and kindred arts, and we cannot resist quoting the following eloquent passage, which justifies (if justification were necessary) his course:—

> My chief reason for including such subjects as the steam-engine, the strength of materials, and some great examples of construction, and the electric telegraph, is that these important practical improvements are both historically and logically interwoven with the progress of pure and abstract Physics. They have besides

impressed upon the character of scientific discoveries of the last hundred years a peculiar stamp which it would have been absurd to ignore while endeavoring, within a moderate compass, and in the plainest language, to convey a vivid though comprehensive sketch of the advancement of natural philosophy during this and the preceding, or, rather, two preceding generations.

It is not to be imagined that the difficulty of the problems which occupy the speculative philosopher, or the comprehensiveness of mind required for their solution, diminishes in any degree as we descend from the regions of pure science to the walks of every-day life—from the vast periods and majestic motions which astronomy enables us to explain and predict, to the common details of the workshop and the railway. In fact, the former are to be regarded as the *simpler* investigations, whilst our terrestrial agents have their effects modified by the diversified states of aggregation and various mechanical properties of matter, and by the numerous modifications of force arising from heat, electricity, or magnetism, to which it may be exposed. We have as yet made an insignificant advance towards that completer system of natural philosophy of which Newton's will form but one section, in which all the properties of matter and their consequences shall be as well understood as the particular property of gravity is at present. Many of these are to be learned by daily observation of the effects which occur in the ordinary progress of civilisation amongst us. We are continually performing experiments on a great scale and on purely commercial principles, which no individual philosopher or merely scientific society could have ventured to attempt. And in the midst of these appeals to experience, unexpected results are frequently occurring which send us back once more to the study of first principles, which, indeed, while they confound the empiric, do but establish the reputation of the philosophic engineer, who seldom fails to turn them to good account, both in his theory and practice.

We have already expressed our opinion of the manner in which Professor Forbes has performed his task, and so much pleasure have we derived from this performance that we almost feel convicted of ingratitude when the suggestion rises, that our author, in his selection of names for biographical record, has not been quite free from a spice of nativism, or (shall we say?) of that local partiality from which the modern Athens is no more exempt than was the ancient. Certainly, we think the space devoted to one or two individuals might have been curtailed without injury to the work. This, however, is but a small matter, and does not affect its sterling value. To give any abstract or condensation of the subject does not seem feasible within our limits, and we prefer that our readers should take our word that this dissertation is alike essential to the historical student and to him who wishes to take in at one view the many featured image of modern science. If we were to single out particular portions for praise, we should select the biography of Laplace, the history of the discovery of Neptune, the wonderfully curious establishment of the undulatory theory of light by Young and Fresnel, and the glowing descriptions of the dis-

coveries of Davy and Faraday. Perhaps the least satisfactory portion is that on sidereal astronomy. The account of Sir W. Herschel's labors might have been elaborated with more detail, and now that the author of the "Plurality of Worlds" has rendered the "nebular hypothesis" orthodox, we may venture to say that a better account (barring Comte's mistake) than the one Professor Forbes refers to is to be found in that tabooed work, "The Vestiges." We see no reason why the remarkable experiments of Plateau should not have been mentioned in connection with it.

One of the not least advantages of Professor Forbes's arrangement is the interesting contrasts which the personal characters of these heroes—sometimes martyrs—of science present. Consider, for instance, Cavendish, "the descendant of one of England's noblest families, and the possessor of enormous wealth, yet neither of these powerful temptations could withdraw him even for an hour from the course of study which he had marked out, and which constituted for him at once labor and relaxation, the end of living, and almost life itself." He lived for four-score years almost isolated from human intercourse, showing an entire indifference to the ordinary passions and ambitions of mankind; indifferent even to scientific fame, and so strangely incommunicative as to leave much of the nature of his long studies only to be discovered from his manuscript remains. Dr. George Wilson has described him, with characteristic eloquence, as a "wonderful piece of intellectual clock-work. As he lived by rule, so he died by it, predicting his death as if it had been the eclipse of some great luminary, ... and counting the very moment when the shadow of the unseen world should enshroud him in its darkness." Contrast with him Davy, the apothecary's apprentice of Penzance, rising in early manhood not only to be the acknowledged leader of chemical science, but also a star of fashion in aristocratic circles; gifted with an ardent and impulsive genius, which enabled him to take theories by storm, and with a fervor of imagination which threw round his great discoveries a poetic glow that dazzled the external world; disdaining to realise money from his inventions, many of which were singly worth a fortune, careless of health and life itself in untried experiments, and in all stages of his short but varied life "acquitting himself gracefully and well." Add to these Wollaston, whose discoveries in chemistry were of hardly less practical value than those of Davy, and who was moreover an original and successful observer in almost every department of philosophy; yet he was quite unknown to the world at large, and appreciated even by few of his contemporary brethren in science. We borrow the following graphic comparison from the dissertation :—

While Davy was delighting crowded audiences with his eloquence, his discoveries, and their wonderful results, Wollaston was pursuing his solitary experiments on a scale so small that scarcely three persons could witness them at once. While Davy was firing his potassium with ice, and making mimic volcanoes heave by the oxidation of his new metals, Wollaston was extracting, by minute analysis, from the refractory and unoxidable ores of platinum, substances previously undetected, which, neither by their quantity nor their characters, could ever interest any but a man of science. While Davy was charging his prodigious battery of 2500 pairs—the largest which has ever been constructed (a homage to his genius, provided by his numerous admirers)—Wollaston was proving, after his fashion, how similar effects could be produced by the very same agency on a small scale; and with no greater apparatus than a sheet of zinc, a few drops of acid, and an *old thimble*, he would gratify his friends by exhibiting the mimic glow of an almost microscopic wire of platinum.* Davy seemed born to believe, Wollaston to doubt. Davy was a poet; Wollaston a mathematician, or, at least, capable of becoming a great one. Davy announced his discoveries in fiery haste, and presented all their consequences and corollaries as a free gift to mankind; Wollaston (estimating more truly the rarity of the inventive faculty,) hoarded every observation, turned it over and over, polished it, rendered it exact beyond the reach of criticism, and then deliberately laid it before the world. He had the coldness and the accuracy of Cavendish, but he lacked the spur of his genius, and the wide grasp of his apprehension. Among other legitimate results of discovery, Wollaston was not unwilling to claim for his own the material benefits which such researches sometimes, though rarely, yield; whilst Davy, as we have seen, spurned every possible attribution of an interested motive. Davy never made a shilling in his life, save as an author or a lecturer, (except as paid assistant to Dr. Beddoes); Wollaston realised a fortune by his art of working platinum. Davy was admired by thousands at home and abroad; Wollaston was little known except to a small circle who could appreciate the resources of a mind rarely opened in confidence to any one, and of which the world was only partially informed. The composure of his death-scene rivalled that of Black and Cavendish. His disorder was one of the brain. When he had lost the power of speech, his attendants remarked aloud that he appeared unconscious. Making a sign for a pencil and paper, he wrote down a column of figures, added them up correctly, and expired.

A still different type is presented by Dalton; born in humble circumstances, a consistent Quaker through life, scantily educated, and laboring under disadvantages of person and manner: he maintained himself in a grade barely above poverty by private teaching, and without friendly encouragement, with deficient means, and apparatus rudely constructed by his own hands, we find him making discoveries by which the world now ranks him as the very first in the annals of Chemistry, yet which were at the time but coldly acknowledged; nor was it till towards the close of a long life that scientific honors were

* So wonderful was his skill in dealing with the minutest quantity of a substance, that it used to be said—give him a scrap of mineral only visible in the microscope, and he will tell you not only what it is, and where it came from, but also the name of the person who quarried it!

awarded to him, and the burden of his daily labor for a livelihood lightened by a small pension from Government. We might go on quoting instance after instance to show how the divine gift of Philosophy is indifferently contained in vessels of every mould and substance, but shall only give one more—the last and perhaps the greatest (one only excepted) the world has yet received—Thomas Young. Like Dalton, born a Quaker, but, unlike him, in easy circumstances and soon throwing off the technical characteristics of his sect: self-educated, he became in early life "an accurate classical scholar; perfectly familiar with the principal European languages; well acquainted with mathematics, and with almost every department of natural philosophy and natural history; profoundly versed in medical and anatomical knowledge, and in possession of more than ordinary personal and ornamental accomplishments."* It is only within the last few years (though Young died in 1829) that the value of his extensive labors has been fully appreciated; to enter into them would require a separate article; we can only endorse Professor Forbes's belief that "since Newton (*or before him*) Thomas Young stands unrivalled in the annals of British (*or any other*) Science."

It is interesting to notice the very different tracks along which the course of discovery has moved. Sometimes, though not often, the exact Baconian method has been followed, a method which it has long been the fashion to applaud as the only one, but which Bacon's latest editor justly characterises as more adapted to the exclusion of error than the detection of truth; more frequently, an idea, instinctively seized upon, has been worked out to its full establishment as a natural law; sometimes, a single fortunate experiment has given rise to a whole series of discoveries; while in other cases, some simple law has long been hidden, though involved in numerous experiments, from the eyes of observers, and has only been dragged to light by one coming after them, reaping the fruit which they had sown. It is not uncommon to hear of the large share which accident, so called, has had in the progress of scientific discovery, but an attentive consideration of this progress dispels such a notion. Accidents, it is true, do happen, and are happening every moment: it is only when one happens at the right time and place that results ensue: the seeds of science lie scattered everywhere; where the soil and circumstances are suited to them, they grow. As the German proverb says—"The world is the same to all, but each eye sees only what it brings with it the power of seeing." We cannot resist quoting Professor Forbes's account (as a model of research) of the invention of the Davy Lamp, often told before but never so well.

* Peacock—Life of Young.

The lamentable loss of life occurring in coal mines from explosions of fire-damp or inflammable air disengaged from the workings, had for many years attracted the attention and sympathy of the public, and had likewise been carefully considered by scientific men. The explosive gas was known to be the light carburetted hydrogen. Two plans alone seemed to present themselves for diminishing the danger :—the one, to remove, or chemically to decompose the fire-damp altogether; the other, to provide a miners' lamp which, by its construction, should be incapable of causing explosion. The former of these modes of protection, it was soon seen, could only be palliative ; the only efficient form which it took was that of a more effectual ventilation; but the terrific rapidity with which a mine may be suddenly invaded by fire-damp, from channels opened by a single blow of the pickaxe, must prevent it from ever acting as a *cure*. The latter plan had as yet yielded nothing more effectual than the *steel mill* long used by miners, which produced an uncertain and intermitting light, by the rotation of a steel wheel against a flint, the scintillations of which were incapable of inflaming the fire-damp. The insufficiency of the light prevented it from being used, except in circumstances of known danger. The celebrated Baron Humboldt, Dr. Clanny, and several others had invented safety lamps on different principles, but they were all clumsy and more or less ineffectual.

At last, in the summer of 1815, the Rev. Dr. Gray, (afterwards Bishop of Bristol,) then Chairman of a committee appointed by a benevolent association at Bishop Wearmouth for the prevention of colliery accidents, applied to Davy, who was then on a sporting tour in Scotland, requesting his advice and assistance. Sir Humphry answered the call with promptitude. On his southward journey, in the latter part of August, he visited the collieries, ascertained the circumstances of the danger which he had to meet, and was provided by Mr. Buddle with specimens of the inflammable air for examination. Within a fortnight after his return to London, he had ascertained new and important qualities of the substance, and had already four schemes on hand for the prevention of accident. Before the end of October, he had arrived at the following principles of operation in connection with a safety-lamp :—"First. A certain mixture of azote and carbonic acid prevents the explosion of the fire-damp, and this mixture is necessarily formed in the safe-lantern. Secondly. The fire-damp will not explode in tubes or feeders of a certain small diameter. The ingress to, and egress of air from any lantern," he adds, "is through such tubes or feeders; and, therefore, when an explosion is artificially made in the safe-lantern it does not communicate to the external air." The effect of narrow tubes in intercepting the passage of flame is due to the cooling effect of their metallic sides upon the combustible gases of which flame is composed ;* and one of his first and most important observations was the fortunate peculiarity that fire-damp, even when mixed with the amount of air most favorable to combustion (1 part of gas to 7 or 8 of air), requires an unusually high temperature to induce combination. Olefiant gas, carbonic oxide, and sulphuretted hydrogen are all inflamed by iron at a red heat, or ignited charcoal, but carburetted hydrogen does not take fire under a perfect white heat. The earliest safety-lamp consisted of a lantern with horn or glass sides, in which a current of air to supply the flame was admitted below by numerous tubes of small diameter

* This prime fact Davy had obtained from a committee of the R. S. which had been appointed to examine the possibility of gas-explosions being caused by the flame running back through the piping into the gasometer.

or by narrow interstices between concentric tubes of some length; or finally, by rows of parallel partitions of metal, forming rectangular canals extremely narrow in proportion to their length. A similar system of escape apertures was applied at the top of the lantern.

With characteristic ingenuity, Davy did not stop here. He continued to reduce at once the apertures and length of his metallic guards, until it occurred to him, that *wire gauze* might, with equal effect, and far more convenience, act upon the temperature of flame, so as to reduce it below the point of ignition, and thus effectually stop its communication. The experiment was successful, and by the 9th November, 1815, or within about ten weeks after his first experiments, an account of the safety-lamp defended by wire gauze was presented to the Royal Society. About two months later he produced a lamp entirely enveloped in metallic tissue.

There are none of Davy's researches which will stand a closer scrutiny than those which terminated thus successfully. No fortuitous observation led him to conceive a happy idea and to apply it to practice. A great boon to humanity and the arts was required at his hands; and, without a moment's delay, he proceeded to seek for it under the guidance of a strictly experimental and inductive philosophy. Without, perhaps, a single false turn, and scarcely a superfluous experiment, he proceeded straight to his goal, guided by the promptings of a happy genius, aided by no common industry. The chemical, the mechanical, and the purely physical parts of the problem were all in turn dealt with, and with equal sagacity. It may be safely affirmed that he who was destitute of any one of these qualifications, must have failed in attaining the object so ardently desired, unless by the aid of some rare good fortune.

In comparing the biographies of foreign celebrities with those of British origin, we cannot help being struck with a difference that manifests itself in the treatment they receive from their respective countries. Abroad, we find that the successful cultivators of science are raised to places of dignity and trust in the State, adorned with distinctions of crosses and ribands, and liberally provided for, when necessary, by honorable pensions; not a few of them accomodated with titles of nobility in acknowledgment of their services. At home, on the contrary, with the exception of a few knighthoods (rather indiscriminately conferred), and now and then a solitary baronetcy, or perhaps a small pension grudgingly bestowed, we find no official recognition of the status of a man of science. This has sometimes, by foreigners, been made the ground of illiberal comparison, yet surely without due consideration. The indiscriminate bestowal of such honors as are extended to men of science in England, sufficiently proves how incapable are the political advisers of the Crown to form a court of honor for her intellectual peerage. A Royal Society presidency, or a Wollaston medal, constitute far fitter honors for a Newton or a Lyell than the legislative honors and functions which supply the highest reward for the successful soldier or lawyer; while the loss is that of the

exclusive order of hereditary legislators and not of the men of science. The order of England's peerage would certainly have sustained no degradation, had it been able to reckon among its noble descents, those who counted kin with the Lincolnshire farmer's boy, or with the son of the German drummer who added so largely to the domain of knowledge by his brilliant genius and varied talents ; but it may be doubted if either Newton or the Herschels would have been the gainers by their transference from the ranks of England's untitled nobles, to those of her hereditary peerage. Foreign sneerers and domestic grumblers may consider these things and learn wisdom, or, at the least, gather the comforting conviction, that if British science has gone on so well and long without the bedizenment of aristocratic trappings, these latter may not be essential to her still further progress. We earnestly hope that Professor Forbes may live to record, for the next quarter-century, even greater achievements than those which he has here so admirably set forth.

J. B. C.

SCIENTIFIC AND LITERARY NOTES.

PHYSIOLOGY AND NATURAL HISTORY.

ABNORMAL INDIAN CORN.

Dr. H. Boys, of Barrie, in a letter to Professor Croft, of date 29th July, thus writes ; " In the last number of the Canadian Journal, at p. 309, Professor Wilson is stated to have read before the Institute some remarks on a specimen of Indian corn, having male and female flowers developed on the same stalk. In reference to this I send you a rough sketch I made some years back of a similar anomaly, which fell under my own observation. You will perceive this case offered more deviations from nature than are mentioned in the Journal as being noted by Professor Wilson. I consider the subject one involving points of the greatest interest to animal and vegetable physiologists. In thus noting the deviations occurring in the simple structure of vegetables, an opportunity may be afforded of investigating such phenomena, with a fair chance of leading to important results. I hope the subject will not be allowed to drop. All I can promise to do is to look out for fresh instances, and should I be so fortunate as to observe such this season, I shall endeavour to make more careful drawings and more minute and accurate remarks, and shall send you the result."

In the sketch which accompanies the letter of Dr. Boys, the branched spike of male florets is seen with a considerable group of the female introduced among

them, and in this group still further anomalies are noticeable. While the greater number of the florets are females, some of them are hermaphrodite, and others in the same flower have a male and female floret, each with its distinct calyx within the same glumes. The ovum is therefore, in this plant, exhibited in every form of development, and its sex is so capriciously distributed as to favor the idea of some phytologists that the sex is not determined at the origin of the ovum, but by subsequent casual circumstances.

COLEOPTERA.

In the last number of the Proceedings of the Academy of Natural Sciences, of Philadelphia, Dr. Leconte has added to his invaluable series of monographs of North American Coleoptera one on the Pselaphidæ. The paper contains an enumeration of the species and descriptions of those which are new. Of Dyschirius, twenty-eight; Acephorus, one; Ardistomis, four; Aspidoglossa, one; Clivina, twenty-seven; Schizogenius, six.

NEUROPTERA.

Uhler has described seven new species of Libellula, inhabiting the United States.

MOLLUSCA.

Lea describes a number of new species of Naiades, principally Uniones, from Alabama, North Carolina, and other parts of the States. Under the rather curious heading of "Gnotic Species," he describes the following:

Unio Canadiensis. Testâ lævi, triangulari, subcompressa inæquilaterali, posticè obtusè angulatâ, valvulis subcrassis, anticè crassioribus; natibus subprominentibus; epiderme luteâ, postice radiatâ; dentibus cardinalibus parvis, erectis crenulatisque; lateralibus longis, curvis lamellatisque; margaritâ albâ et iridiscente. *Hab.* St. Lawrence River, near Montreal.

THE CANADIAN HUMMING BIRD.

During the present summer we were visited by Mr. John Gould, the distinguished Naturalist, whose chief object in his tour through Canada was for the purpose of studying the habits and manners of the species of *Trochilus* frequenting this portion of the North American Continent. Shortly after his return to England, at a meeting of the London Zoological Society, Mr. Gould detailed some of the results of his observations. He arrived in Canada just before the period of the migration of these beautiful little birds from Mexico to the north, and had ample opportunities for observing them in a state of nature. Their actions he described as very peculiar and quite different from those of all other birds; the flight is performed by a motion of the wings so rapid as to be almost imperceptible; indeed, the muscular power of this little creature appears to be very great in every respect, and independently of its rapid and sustained flight, it grasps the small twigs, flowers, &c., upon which it alights with the utmost tenacity. It appears to be most active in the morning and evening, and passes the middle of the day in a state of sleepy torpor. Occasionally [illegible] in such numbers that fifty or sixty may be seen in a single tree. When captured [illegible] so speedily becomes tame that it will feed from the hand or mouth within half an hour. Mr. Gould having been successful in keeping one alive in a gauze bag attached to his breast button for three days, during which it readily fed from a small bottle filled with a syrup of brown sugar and water, he determined to make an attempt to bring some

living examples to England, in which he succeeded, but unfortunately they did not long survive their arrival; had they lived, it was his intention to have sent them to the Zoological Society's gardens, where they would doubtless have been objects of great attraction.

Mr. Gould exhibited a highly interesting species of *Ceriornis*, which he had found in the collection of Dr. Cabot, of Boston, who, with great liberality, permitted him to take it to England for the purpose of comparison and description. For this new bird, forming the fourth species of the genus, Mr. Gould proposes the name of *Ceriornis Caboti*.

CANADIAN INSTITUTE.

FIFTEENTH ORDINARY MEETING.—*4th April*, 1857.

Professor E. J. CHAPMAN, Vice-President, in the Chair.

The following Gentlemen were elected Members:

WILLIAM ANDERSON, Esq., Toronto.
W. H. BOULTON, Esq., Toronto.

The following Reports of Committees were then read:

1. The BARON DE ROTTENBURG submitted to the meeting, the Report of the Committee on Mr. Ketchum's offer of two acres of land on Yonge Street, for an Astronomical Observatory, recommending the acceptance of the gift, and an application to the Government for aid to accomplish the object in view.

On motion of Professor Croft, seconded by J. G. Hodgins, Esq., the Report was approved of, and it was resolved, that Mr. Ketchum's offer be accepted, and that a copy of the report be transmitted to him, with a special vote of thanks of the Institute for his generous donation.

2. Professor WILSON submitted to the meeting, the Report of the Building Committee, detailing the steps which have been taken by the Committee towards the erection of the proposed new building for the Institute, on the site presented by G. W. Allan, Esq., for that purpose, on Pembroke Street.

On motion of A. H. Armour, Esq., seconded by Dr. George Beattie:
It was resolved, that the Report be adopted.

The following papers were then read:

1. By the BARON DE ROTTENBURG:—

"On the Planetary appearance of stars of the 1st and 2nd magnitudes, on the night of the 12th March, and the occultation of Spica Virginis by the moon, on the morning of the 13th March, 1857."

2. By Professor CHAPMAN:

A communication from Dr. G. D. Gibb, of London, England: "On calcareous concretions from Buckinghamshire, England, which have excited considerable attention recently, from certain examples figured and described in the *Illustrated London News*, as vegetable fossils."

Professor Chapman exhibited, and commented on a collection of these English concretionary bodies, presented to the Institute, through Dr. Gibb, by Mr. Stowe of Buckingham: and also exhibited and presented to the Institute, specimens of some peculiar silicious concretions,—hitherto, he believed unnoticed,—from the Black River Limestone, of the Lake of St. John, near the Indian village of Rama, lying to the north-east of Lake Simcoe, Canada West.

SIXTEENTH ORDINARY MEETING.—18*th April*, 1857.

Col. BARON DE ROTTENBURG, Vice-President, in the Chair.

The following Donations for the Library were announced, and the thanks of the Institute voted to the Donors:

1. From the Geological Society of Dublin:
"Vols. 1, (wanting part 1,) 2, 3, 4, 5, 6, and part 1 of vol 7, of the Journal of the Geological Society of Dublin."

2. From the Author:
"Observations on the construction of an Hospital for the Insane. (Pamphlet.) By B. R. MORRIS, B.A., M.D.,:
"Theory as to the cause of Insanity, (Pamphlet.) By B. R. Morris, B.A., M.D."

The following Gentlemen were elected Members:

OLIVER WELLS, Esq., Crown Land Department, Three Rivers, C. E.

CHARLES B. CHALMERS, Esq., F.R.A S., Barrie, C.W.

The following papers were then read:

1. By Prof. CHERRIMAN, M.A., :
"On Vision."

2. By J. HIRCHFELDER, Esq., :
"Observations on bedding out plants."

3. By Professor CHAPMAN:
"On the occurrence of the Genus Cryptoceras in Silurian Rocks."

This being the last meeting of the Session, T. W. Birchall, Esq, and Samuel Spreull, Esq., were appointed Auditors, in accordance with the laws. The Chairman, after congratulating the members on the prosperous state of the Institute, and the valuable communications from time to time submitted to the meetings, by which their attraction have been maintained with undiminished interest, invited the attention of the members to such subjects of scientific value as might come under their notice during the summer recess, with a view to communications to be brought under the notice of the Institute, either through the medium of the Journal, or at the meetings of next session, and adjourned the meeting till November.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—JUNE, 1857.

Latitude—43 deg. 39.4 min. North. Longitude—79 deg. 21 min. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Mean Temp. +or— of the Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Re-sultant Direc-tion.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN	6 A.M	2 P.M	10PM	ME'N		6 A.M	2 P.M	10 P.M	M'N	6 A.M	2 P.M	10 P.M	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M	2 P.M	10PM	Re-sul't.	ME'N		
1	29.259	29.241	29.216	29.2373	°52.7	°63.5	°56.1	°57.62	°+ 0.67	.368	.448	.361	.391	.94	.79	.81	.84	Calm.	S E b S	Calm.	S °19 W	0.0	9.6	0.0	2.73	3.62	0.010	...
2	.222	.234	.300	.2582	54.1	56.6	47.6	52.83	— 4.43	.304	.278	.254	.284	.74	.62	.77	.72	W b S	W b S	Calm.	S 65 W	12.0	14.5	0.0	6.96	7.44	0 025	...
3	.235	.269	.340	.2923	49.8	62.5	48.9	53.02	— 4.53	.309	.337	.315	.319	.88	.61	.92	.81	NW b N	S b W	S W	S 88 W	0.2	8.0	7.4	5.30	7.21	0.440	...
4	.487	.539	.593	.5457	46.2	53.0	47.2	49.10	— 8.75	.240	.222	.191	.220	.79	.56	.59	.64	W b N	S S W	N b W	N 75 W	10.8	9.8	9.0	5.46	7.85	...	...
5	.603	.588	.555	.5808	40.9	52.8	48.4	48.35	— 9.80	.196	.262	.172	.215	.77	.67	.51	.64	W N W	NW b W	SW b W	N 77 W	5.0	16.0	2.2	6.52	7.06	0.010	...
6	.519	.425	.296	.4028	44 7	64.6	53.2	55.03	— 3.42	.219	.200	.304	.260	.75	.33	.76	.63	W	W b S	S W	S 71 W	4.5	17.2	1.6	7.29	8.07	0.080	...
7	.223	.294	—	—	49.2	60.1	—	—	—	.321	.383	—	—	.93	.75	—	—	E b S	S E b E	NE b N	N 77 E	1.5	10.6	5.0	5.39	6.08	Inap	...
8	.417	.434	.406	.4188	54.5	54.5	58.1	55.38	— 3.68	.298	.378	.442	.380	.72	.90	.93	.88	N E b E	E N E	E N E	N 68 E	11.6	12.8	8.8	10.40	10.46	0.350	...
9	.475	.536	.573	.5280	53.0	57.7	55.9	55.08	— 4.40	.384	.409	.403	.397	.97	.88	.92	.93	E N E	E b S	S W	S 79 E	6.4	6.6	0.4	2.36	3.45	0.035	...
10	.556	.425	279	.4092	56.6	67.1	57.1	60.48	+ 0.70	.430	.492	.411	.449	.96	.76	90	.87	S W b S	S	E N E	N 80 E	1.0	5.4	8.2	2.96	6.64	...	...
11	037	28.974	.088	.0220	58.8	57.5	55.0	57.32	— 2.67	.468	.379	.286	.363	.96	.82	.68	.78	N N E	N W	W N W	N 48 W	9.8	24.4	11.5	13.18	15.41	0.605	...
12	.176	29.052	.194	.1455	50.9	65.7	52.7	57.08	— 3.18	.243	.445	.357	.365	.66	.72	.91	.79	W b N	S S W	SW b S	S 39 W	11.2	17.0	1.8	5.46	6.52	0.230	...
13	.233	.257	448	.3303	57.4	70.2	56.0	60.97	+ 0.38	.387	.320	.264	.332	.84	.44	.60	.65	Calm.	W	N W	N 78 W	0.0	19.0	8.6	9.17	10.87	Inap	...
14	.591	.643	—	—	49.8	62.4	—	—	—	.248	.345	—	—	.71	.63	—	—	W b N	S b E	N b W	S 85 W	4.4	6.2	5.5	2.14	6.23	...	...
15	.695	.683	.620	.6547	51.8	55.7	51.6	54.45	— 6.68	.273	.287	.275	.288	.72	.66	.74	.69	N b W	N E b E	E b N	N 70 E	3 8	9.2	7.6	8.34	8.54	0.030	...
16	.512	.524	.399	.4717	53.7	54.5	51.2	52.67	— 8.68	.387	.289	.326	.322	.96	.69	.88	.83	E b N	E b N	E b N	N 75 E	17.2	14.7	19.0	17.21	17.22	0.195	...
17	.355	.400	.438	.3953	49.6	62.8	52.7	54.85	— 6.80	.325	.459	.368	.383	.93	.83	.94	.90	E b N	N E	E	N 75 E	12.2	3.4	9.5	7.77	8.00	0.005	...
18	.398	.305	.318	.3390	54.1	59.7	53.0	55.03	— 6.92	.392	.438	.364	.388	.96	.87	.93	.91	E b N	E N E	S S W	S 66 E	10.0	8.0	5.8	3.64	6.24	0.085	...
19	.323	.302	.382	.3392	54.7	60.7	51.9	55.83	— 6.30	.359	.384	.339	.353	.86	.75	.89	.81	S b E	S	S W b S	S 8 W	10.0	17.0	8.0	10.00	10.18	...	...
20	.415	.353	.418	.3962	53.2	54.8	52.7	53.58	— 8.87	.342	.396	.373	.362	.86	.94	.96	.90	S S W	E	E b N	S 89 E	4.3	5.0	0.5	3.60	4.03	0.880	...
21	.475	.498	—	—	52.7	59.7	—	—	—	.338	.438	—	—	.87	.87	—	—	E b N	S b E	E S E	S 22 E	0.4	4.2	4.2	1.10	4.50	0.145	...
22	384	.363	.476	.4107	54.8	58.8	53.4	55.25	— 7.70	.354	.380	.380	.372	.84	.78	.95	.87	N b W	N N W	N W	N 34 W	11.5	14.8	16.7	13.70	14.52	0.395	...
23	.584	.602	664	.6167	51.4	65.1	53.0	56.83	— 6.32	.296	.327	.326	.316	.80	.54	.83	.71	W N W	N W	SW b W	N 62 W	8.0	10.4	1.2	5.67	6.75	...	...
24	.695	.653	.653	6610	47.6	63.9	61.0	58.98	— 4.37	.284	.406	.288	.338	.88	.70	.55	.69	SW b W	S W b S	N N W	S 75 W	1.4	7.6	6.0	2.52	4.50	...	...
25	.693	.622	.598	.6375	53.7	72.2	66.2	64.32	+ 0.77	.337	.449	.376	.395	.83	.58	.60	.68	W N W	S W b S	NW b N	S 69 W	2.4	10.2	7 0	3.04	5.16	...	...
26	.648	.638	.601	.6320	65.0	71.8	65.0	68.42	+ 4.53	.364	.370	.424	.422	.61	.49	.71	.63	NW b N	E b S	S b W	S 20 W	0.5	4.2	1.9	1.90	2.95	0.105	...
27	.647	.593	.565	.5953	62.4	73.1	63.7	66.47	+ 2.40	.485	.537	.445	.501	.88	.68	.78	.80	NW b W	E b S	N b E	N 72 E	3 2	6.8	6.0	1.92	3.58	...	...
28	.544	.476	—	—	62.1	73.6	—	—	—	.467	.584	—	—	.86	.73	—	—	Calm.	E b S	W S W	N 67 E	0.0	6.4	1.5	2.47	4.44	0.265	...
29	.405	.397	.386	.3945	64.6	68.6	61.7	64.52	+ 0.07	.559	.523	.345	.457	.95	.77	.63	.77	N	N	N W	N 36 W	7.0	13.0	9.5	10.45	10.86	1.070	...
30	.368	.397	.378	.3807	55.2	60.8	52.5	56.43	— 8.15	.271	.308	.332	.307	.63	.59	.86	.69	W N W	W b S	SW b W	S 82 W	17.5	16.0	0.8	8.12	9.60	...	...
M	29.4362	29.4156	29.4302	29.4267	53.52	61.85	54.84	56.92	— 4.11	.341	.374	.335	.353	.83	.69	.79	.77	....	....	....	....	6.26	10.93	5.84	......	7.60	5.060	...

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR JUNE, 1857.

Highest Barometer . . . . 29.707 at 8 a.m. on 25th } Monthly range=
Lowest Barometer. . . . . 28.952 at 8 a.m. on 11th } 0.755 inches.

Self-registering Ther.
Maximum temperature . . . . 76°0 on p. m. of 28th } Monthly range=
Minimum temperature . . . . 35.0 on a. m. of 5th } 41°0
Mean maximum temperature . . 65°48 } Mean daily range = 16°49
Mean minimum temperature . . 48°99 }
Greatest daily range . . . . 24°4 from a. m. to p. m. of 6th.
Least daily range . . . . 7.6 from p. m. of 16th to a. m. of 17th.

Warmest day . . 26th ... Mean Temperature . . . 68°42 } Difference=20°07.
Coldest day . . . . 5th ... Mean Temperature . . . 48.35 }

Maximum. { Solar . . . . 93°5 on p. m. of 28th } Monthly range=
Radiation. { Terrestrial . . . . . . 26.0 on a. m. of 5th } 67°5

Aurora observed on 1 night, viz.: 11th at 9 p.m, (faint); possible to see Aurora on 14 nights; impossible to see Aurora on 16 nights.

Raining on 21 days; depth, 5.060 inches; duration of fall, 66.0 hours.

Mean of cloudiness=0.69; most cloudy hour observed, 8 a. m., mean=0.83: least cloudy hour observed, 10 p. m.; mean=0.55.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
1743.47	1193.80	1669.75	2293.65

Resultant direction of the wind, N 49° W; Resultant Velocity, 1.15 miles per hour.

Mean velocity of the wind 7.60 miles per hour.
Maximum velocity . . . 28.6 miles per hour, from noon to 1 p. m. of 11th.

Most windy day . . . . 16th—Mean velocity, 17.22 miles per hour.
Least windy day . . . . 26th—Mean velocity, 2.95 do

Most windy hour 1 to 2 p.m.—Mean velocity, 11.26 do } Difference
Least windy hour 2 to 3 a. m.—Mean velocity, 5.38 do } 5.88 miles.

3rd—Very perfect rainbow at 7 p.m.
5th—Slight hoar frost at 5.30 a. m.
15th—Particles of snow stated to have fallen at 1 p. m., in King Street.
18th—Very dense fog during most of the day.
22nd—Large and very perfect rainbow at 8 p. m.; prismatic colours well defined.
24th—Large and perfect solar halo at 5.30 a. m. Wild pigeons numerous.
25th—Fire-flies first noticed, at 9 p. m., in the ravine near the Observatory.
27th—A considerable quantity of Pollen fell with the rain which occurred at 5.50 a.m.

Temperature—This was the coldest June, and shews also the lowest maximum temperature since 1842.

Rain—The number of rainy days exceeded that of any previous June, and the depth of rain, 1.897 inches above the average, is the greatest recorded for June since 1842.

Wind—The mean velocity of the wind was greater than any before recorded for the month of June.

The resultant direction and velocity of the wind for the month from 1848 to 1857 were N 87° W 0.51 miles per hour.

COMPARATIVE TABLE FOR JUNE.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	No. of days.	Inches.	No. of days.	Inches.	Resultant Direction.	Resultant Velocity.	Mean Velocity
1840	59.8	— 1.4	78.5	37.1	41.4	11	4.860	...	...	—	—	—
1841	65.6	+ 4.4	92.8	45.7	47.1	9	1.560	...	...	—	—	0.36 lbs
1842	55.6	— 5.6	73.9	28.0	45.9	15	5.755	...	...	—	—	0.31 "
1843	58.4	— 2.8	81.3	28.5	52.8	12	4.595	...	...	—	—	0.27 "
1844	59.9	— 1.3	82 8	33.1	49.7	9	3.535	...	...	—	—	0.19 "
1845	61.0	— 0.2	83.6	40.9	42.7	11	3.715	...	...	—	—	0.27 "
1846	63.3	+ 2.1	83.3	41.5	41.8	10	1.920	...	...	—	—	0.32 "
1847	58.4	— 2.8	78.3	36.7	41.6	14	2.625	...	...	—	—	0.30 "
1848	62.9	+ 1.7	92.5	38.3	54.2	8	1.810	...	...	N 61 W	1.90	4.51mls
1849	63.2	+ 2.0	84.9	45.2	39.7	7	2.020	...	...	S 71 E	0.49	3.32 "
1850	64.3	+ 3.1	83.2	49.0	34.2	10	3.345	...	...	S 60 W	0.38	4.54 "
1851	59.2	— 2.0	79.2	41.2	38.0	11	2.695	...	...	S 2 W	1.26	4.42 "
1852	60.8	— 0.4	86.1	43.6	42.5	10	3.160	...	...	S 76 W	1.49	4.09 "
1853	65.5	+ 4.3	86.3	43.3	43 0	9	1.550	...	...	N 14 W	0.27	3.67 "
1854	64.1	+ 2.9	88.7	47.4	41.3	9	1.460	...	...	N 21 E	0.80	4.12 "
1855	59.9	— 1.3	90.7	40.6	50.1	17	4.070	...	...	N 69 W	1.33	5.70 "
1856	62.1	+ 0.9	82.6	48.3	34.3	13	3.200	...	...	S 21 W	0.90	5.30 "
1857	59.9	— 4.3	75.1	40.9	34.2	21	5.060	...	...	N 49 W	1.15	7.60 "
Mean	61.16	...	83.55	40.52	43.03	11.4	3.163	...	...	—	—	4.73

MONTHLY METEOROLOGICAL REGISTER AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—JULY, 1857.

Latitude—43 deg. 39.4 min. North. Longitude—79 deg. 21 min. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°. 6 A.M.	2 P.M.	10 P.M.	Mean.	Temp. of the Air. 6 A.M	2 P.M	10 PM	ME'N	Mean Temp. + or — of the Average	Tens. of Vapour. 6 A.M	2 P.M	10 P.M.	M'N	Humidity of Air. 6 A.M	2 P.M.	10 P.M.	M'N	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Resul't. Direc-tion.	Direction of Wind. 6 AM.	2 PM.	10 P.M.	Re-sult'.	ME'N	Rain in inches.	Snow in inches.
					°	°	°	°	°												°							
1	29.396	29.495	29.568	29.4963	52.4	57.1	54.6	54.65	—10.12	.343	.384	.346	.360	.88	.84	.83	.86	E N E	E b N	N E b E	N 66 E	5.4	15.5	16.2	13.92	14.08	0.030	...
2	.644	.720	.720	.7042	54.1	60.2	53.4	56.45	— 8.55	352	334	302	329	86	64	75	74	N E b E	E	E N E	N 76 E	14.4	11.0	1.5	6.06	6.15	Inap	...
3	.678	.626	.619	.6400	55.0	67.0	59.7	61.68	— 3.47	342	371	329	359	81	57	65	67	Calm.	S S W	S W b S	S 53 W	0.0	5.2	1.5	1.45	3.93	...	...
4	.667	.672	.718	.6875	58.3	69.5	61.3	63.82	— 1.48	339	488	475	451	71	70	90	78	N b W	S S W	N N W	N 74 W	1.0	7.5	7.9	2.73	5.48	...	...
5	.790	.783	—	—	60.0	70.2	—	—	—	311	432	—	—	61	60	—	—	N N W	S W b S	S b W	S 30 W	6.1	7.0	1.5	1.81	3.41	Inap	...
6	.756	.705	.660	.7013	59.7	71.5	58.1	64.12	— 1.48	341	431	400	403	68	57	84	70	E S E	S E	Calm.	S 69 E	4.4	6.0	0.0	2.64	2.69	...	...
7	.629	.545	.638	.6040	61.3	76.9	65.9	67.78	+ 2.08	475	580	519	537	90	65	84	82	E b S	S W b S	N W b N	N 60 W	2.0	8.2	6.0	3.21	7.14	0.215	...
8	.707	.733	.754	.7350	60.7	69.7	61.3	64.92	— 0.87	428	456	364	424	82	64	68	70	N b W	S b E	W S W	S 27 W	11.0	7.0	4.4	1.41	4.71	...	...
9	.817	.827	.812	.8227	61.0	74.5	60.5	66.42	+ 0.43	398	352	331	370	76	42	64	59	N N W	E	N E	N 57 E	0.5	8.5	3.4	3.97	5.15	...	...
10	.827	.815	.801	.8143	62.8	73.6	65.3	68.50	+ 2.42	366	531	478	463	65	66	78	68	N	S	S E	S 41 E	3.8	5.5	0.4	1.91	2.68	...	...
11	.821	.757	.741	.7667	66.4	80.8	69.5	72.77	+ 6.58	500	.658	636	596	80	65	91	77	Calm	S b E	Calm.	S 13 W	0.0	4.6	0.0	1.76	2.43	...	...
12	.751	.701	—	—	67.8	84.8	—	—	—	570	674	—	—	87	58	—	—	W b N	S b E	S E	S 26 W	1.8	5.0	1.3	1.59	2.45	...	...
13	.663	.584	.592	.6138	70.2	85.0	73.1	76.43	+10.05	609	704	630	649	85	60	80	74	S E	S	S E	S 25 E	1.0	6.0	1.0	2.88	3.05	...	...
14	.585	.523	.509	.5357	69.3	83.0	73.1	75.05	+ 8.63	580	693	618	629	84	63	79	75	S E b E	E b S	N W	S 74 E	1.5	2.7	0.2	2.10	2.85	Inap	...
15	.536	.535	.525	.5258	71.1	81.2	69.7	73.83	+ 7.35	611	671	595	609	83	65	84	76	Calm.	S E b S	N W b W	S 65 E	0.0	3.5	0.4	0.37	1.57	0.515	...
16	.534	.540	.557	.5463	67.7	76.9	68.6	71.15	+ 4.57	615	645	588	618	93	72	87	84	N b E	N	E b S	N 88 E	0.4	5.8	2.2	1.91	2.45	Inap	...
17	.592	.548	.504	.5402	69.3	80.2	71.4	72.90	+ 6.22	612	733	649	657	88	73	87	84	E	S S E	Calm.	S 70 E	0.5	1.5	0.0	1.36	1.50	Inap	...
18	.496	.493	.442	.4668	65.7	83.0	75.4	76.25	+ 9.57	595	696	699	679	97	63	82	78	N E b N	S S W	S W b S	S 14 W	0.8	1.8	5.4	2.65	2.93	...	...
19	.355	.272	—	—	71.8	81.4	—	—	—	674	715	—	—	89	69	—	—	S W b S	S S W	N N W	S 41 W	2.0	10.2	5.5	4.78	7.50	0.050	...
20	.312	.255	.268	.2817	67.5	71.1	61.0	67.40	+ 0.63	574	574	480	533	87	77	91	82	N W b N	S E b S	N W b N	N 31 W	3.2	8.4	0.5	2.52	5.07	0.330	...
21	.291	.297	.324	.3077	61.2	72.0	61.2	64.77	— 2.00	461	517	455	475	88	68	86	80	N W b N	S W b S	W b S	N 81 W	5.5	8.0	4.5	3.28	5.94	0.065	...
22	.371	.421	.491	.4367	60.3	72.2	63.1	65.50	— 1.37	465	483	503	488	91	63	89	80	N	E	E b S	N 81 E	8.0	7.5	0.4	4.22	5.08	...	...
23	.554	.584	.525	.5495	65.7	67.1	64.2	65.93	— 0.95	532	516	548	533	87	80	94	86	N E b E	E S E	N N E	N 23 E	8.4	7.2	9.5	6.75	7.38	0.655	...
24	.507	.530	.603	.5530	62.4	70.0	65.0	65.22	— 1.65	511	611	554	551	95	86	92	91	E N E	S S W	S W b S	S 9 W	7.0	7.2	0.4	1.81	3.38	0.115	...
25	.694	.713	.733	.7187	63.1	77.3	66.9	69.73	+ 2.77	468	764	596	605	83	84	93	85	S W b S	S b E	S b E	S 10 E	3.0	6.0	1.6	3.05	3.25	...	...
26	.764	.735	—	—	63.5	80.8	—	—	—	508	721	—	—	89	71	—	—	Calm.	S S E	E	S 61 E	0.0	6.4	2.4	2.78	3.29	...	...
27	.664	.567	.497	.5670	68.8	82.3	73.1	76.15	+ 9.17	610	747	669	700	90	71	84	81	E b N	S b W	S W b S	S 21 W	2.8	15.4	5.5	8.07	8.61	...	...
28	.447	.524	.622	.5385	71.8	72.9	61.7	68.33	+ 1.37	659	528	413	523	87	67	77	77	S W	N W b N	N W	N 48 W	6.0	16.0	5.0	8.35	9.05	0.240	...
29	.719	.705	.708	.7098	62.4	71.5	65.8	67.37	+ 0.42	453	490	477	477	82	65	77	73	N W b N	S E b E	E b N	S 79 E	1.2	9.0	3.2	3.12	4.37	...	...
30	.646	.587	.515	.5768	64.6	71.1	63.5	67.25	+ 0.30	545	413	508	512	92	56	89	79	E b N	E	N E b E	N 79 E	4.4	10.8	1.0	4.58	4.74	...	...
31	.486	.394	.457	.4447	67.3	73.9	60.1	65.27	— 1.68	590	546	478	521	91	67	95	86	N W b N	W S W	W N W	S 87 W	3.5	7.4	3.8	2.93	4.66	1.260	...
M	29.5940	29.5813	29.5890	29.5883	63.71	73.76	64.69	67.76	+ 1.51	.495	.552	.505	.520	.85	.67	.83	.78	....	....	....	....	3.54	7.48	3.12	...	4.74	3.475	...

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR JULY.

Highest Barometer........................ 29.848 at 8 a. m., on 10th } Monthly range=
Lowest Barometer .... 29.255 at 2 p. m., on 20th } 0.593

Self-registing Thermom.:
- Maximum Temperature..............86.°6 on p. m., of 13th } Monthly range=
- Minimum Temperature...............47°0 on a. m. of 2nd } 39.°6
- Mean maximum Temperature .... 76°79 } Mean daily range=
- Mean minimum Temperature .... 59°32 } 17.47
- Greatest daily range ....24°8 from p. m. of 31st to a. m. of 1st. August.
- Least daily range.................. 8°2 from a. m. to p. m. of 23rd.

Warmest day......... 13th ... Mean temperature......... 76°43 } Difference = 21°78.
Coldest day........... 1st ... Mean temperature......... 54.65 }

Maximum Radiation. { Solar...................................100°5 on p. m. of 18th, } Monthly range=
{ Terrestrial............................ 38°0 on a. m. of 2nd. } 62°5

Aurora observed on 5 nights, viz., 11th, 17th, 22nd, 25th and 28th.
Possible to see Aurora on 22 nights; impossible on 9 nights.

Raining on 15 days,—depth 3.475 inches; duration of fall 43.2 hours.

Mean of cloudiness = 0.46.
Most cloudy hour observed, 6 a. m., mean = 0.55; least cloudy hour observed, 10 p. m., mean, =0.30.

Sums of the components of the Atmospheric Current, expressed in miles.

North.	South.	East.	West.
998.65	1227.18	1401.33	841.14

Resultant direction S. 68° E.; Resultant Velocity 0.81 miles per hour.
Mean velocity............................ 4.74 miles per hour.
Maximum velocity .... 17.4 miles from 4 to 5 p. m. on the 28th.
Most windy day......................... 1st ...Mean velocity 14.08 miles per hour.
Least windy day .... 17th...Mean velocity 1.50 ditto.
Most windy hour ... 3 to 4 p. m.............Mean velocity 7.40 ditto. } Difference
Least windy hour ... 9 to 10 p. m...........Mean velocity 2.89 ditto. } 4.51 miles.

Thunderstorms occurred on the 7th, from ~~2.30 to~~ 3.30 p.m.; 14th, from 6.30 to 8.30 p.m.; 15th, from ~~1.45 p.m.,~~ continuing most of the afternoon; 20th, from 11.15 a.m. to 5.30 p.m.; 21st, about 3 a.m.; 23rd, at 3 a.m., and on the 31st, from 3 to 4 p.m.

Lightning occurred on the 12th at 10 p.m.; 13th, from 10 to 11 p.m.; 17th, at 10 p.m.; 19th, at 9.30 p.m.; 21st, during the evening; 27th, at midnight, and on the 30th at 9 and 10 p.m.

Meteors numerous on the evenings of the 16th, 24th, and 25th.

Fire Flies very numerous on the 15th, from 9 to 11 p.m. Splendid Rainbow on the 19th at 6 p.m. Very heavy Dew on the 26th at 6 a.m. Halo round the moon at 9.30 p.m. on 27th.

Rain.—The number of days on which rain fell was greater than in any previous July, but the depth on the surface was .087 inches below the average.

Wind.—The resultant direction and velocity for July, from 1848 to 1857 inclusive, were S. 81° W., and 0.20 miles per hour.

COMPARATIVE TABLE FOR JULY.

Year.	Temperature.					Rain.		Snow.		Wind.		
	M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range	No. of days.	Inch's.	No. of days.	Inch's.	Resultant. Direction.	Resultant. V'y.	Mean Force or Velocity.
	°	°	°	°	°							
1840	65.8	—1.2	79.4	48.2	31.2	6	5.270	...	...	...	...	....
1841	65.0	—2.0	86.3	43.2	43.1	10	8.150	...	...	...	...	0.27 lbs.
1842	64.7	—2.3	90.5	42.0	48.5	4	3.050	...	...	...	...	0.33
1843	64.5	—2.5	86.1	40.2	45.9	8	4.605	...	...	...	...	0.44
1844	66.0	—1.0	86.1	40.5	45.6	12	2.815	...	...	...	...	0.19
1845	66.2	—0.8	94.6	45.6	49.0	7	2.195	...	...	...	...	0.30
1846	68.0	+1.0	94.0	44.9	49.1	9	2.895	...	...	...	...	0.29
1847	68.0	+1.0	87.5	43.8	43.7	8	3.355	...	...	...	...	0.19
1848	65.5	—1.5	82.7	46.7	36.0	10	1.890	...	...	N 14° W	0.18	4.94 miles
1849	68.4	+1.4	89.1	51.0	38.1	4	3.415	...	...	S 5° W	0.76	3.52
1850	68.9	+1.9	84.9	52.8	32.1	12	5.270	...	...	N 81° E	0.59	4.56
1851	65.0	—2.0	82.7	52.1	30.6	12	3.625	...	...	N 60° W	0.88	4.13
1852	66.8	—0.2	90.1	49.5	40.6	8	4.025	...	...	N 43° W	0.93	3.33
1853	65.6	—1.4	85.4	49.4	36.0	10	0.915	...	...	S 76° E	0.31	3.70
1854	72.5	+5.5	93.6	53.0	40.6	9	4.805	...	...	S 58° W	0.34	4.26
1855	67.9	+0.9	88.4	53.1	35.3	13	3.245	...	...	S 19° W	0.73	6.47
1856	69.9	+2.9	92.0	51.4	40.6	8	1.120	...	...	N 79° W	1.57	5.84
1857	67.8	+0.8	85.4	52.4	33.0	15	3 475	...	...	S 68° E	0.81	4.74
M	67.03	...	87.71	47.77	39.94	9.2	3.562	...	...	...	...	4.55 miles

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—JUNE, 1857.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL.D.

Latitude—45 *deg.* 32 *min. North. Longitude*—73 *deg.* 36 *min. West. Height above the Level of the Sea*—118 *feet.*

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Velocity in miles per hour.			Mean direction of Wind.	Rain in Inches.	Snow in Inches.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 PM	6 A. M	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 PM				6 A. M.	2 P. M.	10 P. M.
1	29.522	29.344	29.439	51.1	80.1	60.0	.361	.648	499	.93	.64	.95	NE by E	s b E	s s w	0.40	0.43	8.37	...	0.200	...	Clear.	C. C. Str. 6.	C. Str. 8.
2	.454	.254	.433	60.1	75.5	58.0	.467	.667	.354	.89	.71	.73	s w b s	s s E	w s w	6.01	2.16	12.50	...	...	...	Cum. Str. 4.	Do. 4.	Clear.
3	.352	.319	.359	57.0	66.0	56.6	.345	.416	.385	.72	.65	.84	w s w	w s w	s w	12.10	10.50	4.02	...	Inp.	...	Do. 2	Cir. Str. 6.	Cir. Str. 4.
4	.414	.502	.626	51.0	57.0	44.5	.293	.355	.234	.77	.74	.74	w	w N w	w b s	0.53	16.57	9.00	...	...	...	Clear.	Do. 8.	Clear. F. Au.
5	.661	.614	.560	40.5	62.3	46.6	.227	.397	.226	.85	.71	.70	NW b w	w b s	w b s	2.08	12.22	10.11	...	...	...	Do.	Do. 6.	C. Str. 4.
6	.528	.514	.437	52.2	62.3	46.2	.304	.397	.291	.76	.71	.89	w s w	w b s	w	1.32	5.60	8.90	...	0.366	...	Do.	Do. 4.	Nimb. 10. Ra.
7	.409	.420	.535	50.0	72.1	54.2	.304	.473	.326	.81	.61	.76	w	w s w	s b w	0.01	0.48	0.21	...	0.266	...	Do.	Do. 4.	Clear.
8	.650	.714	.796	57.0	75.1	67.5	.376	.498	.366	.79	.58	.55	w s w	s	s	0.00	0.00	0.00	...	...	...	Do.	Clear.	C. Str. 2.
9	.712	.764	.793	55.7	78.5	62.0	.351	.498	.421	.79	.52	.75	E	s s E	s s E	0.00	7.56	5.40	...	...	...	C. Str. 4.	C. C. Str. 4.	Do. 6.
10	.656	.546	.515	64.1	85.5	66.5	.504	.692	.544	.84	.58	.85	s b w	s	s	0.10	0.45	0.20	...	...	...	C. C. Str. 6.	Cirr. 2.	Str. 2.
11	.348	.211	28.937	60.0	62.0	58.0	.494	.528	.492	.94	.94	.96	s s E	E s E	s s E	0.22	0.75	3.73	...	1.753	...	Rain.	Rain.	Rain.
12	.017	.168	29.259	57.5	66.1	58.5	.447	.464	.437	.94	.72	.89	w N w	w N w	s w b w	5.85	18.76	8.12	...	0.583	...	Do.	C. C. Str. 6.	Str. 8.
13	.317	.395	.399	54.3	73.4	52.5	.349	.541	.373	.81	.67	.93	s s E	w b s	N w	1.98	5.10	6.03	...	0.334	...	C. Str. 10,	C. Str. 4.	Clear. Thund.
14	.520	.639	.751	51.0	62.5	50.1	.515	.421	.304	.82	.75	.81	w N w	N w	N b w	15.22	19.77	11.17	...	...	...	Str. 4.	Do. 6.	Do.
15	.793	.734	.745	48.7	67.7	54.6	.281	.431	.349	.80	.65	.81	NW b w	NW b w	N E b E	2.80	3.01	7.70	...	...	...	Clear.	Clear.	Do.
16	.813	.713	.720	51.0	65.1	53.6	.293	.425	.361	.76	.68	.87	N E b E	w b s	w	1.67	0.27	0.33	...	...	...	Str. 2.	C. C. Str. 8.	Str. 4.
17	.692	.705	.707	51.0	58.1	53.0	.337	.462	.386	.87	.94	.93	E b N	s s E	s E	0.13	12.12	0.30	...	0.478	...	C. Str. 10.	Rain.	Cir. Str. 8.
18	.630	.629	.625	53.5	59.7	55.6	.394	.452	.432	.96	.89	.93	s s E	E s E	E s E	5.47	7.05	3.55	...	0.389	...	Rain.	Do.	C. Str. 10.
19	.565	.540	.634	57.3	72.1	60.9	.447	.638	.511	.94	.82	.94	s s E	s b w	s s w	2.77	3.23	8.47	...	Inp.	...	C. Str. 4.	C. Str. 10.	Do. 8.
20	.656	.669	.521	65.0	78.1	65.7	.560	.578	.555	.90	.61	.85	w by N	w s w	E N E	1.13	3.02	1.05	...	0.136	...	Cir. Str. 10.	Cum. 1.	Do. 9.
21	.563	.818	.656	62.0	72.3	61.4	.445	.555	.456	.79	.71	.84	w by s	w b s	s w	10.22	6.72	3.41	...	0.186	...	Cum. 4.	C. C. Str. 2.	Cir. Au. Bor.
22	.565	.514	.444	56.9	72.5	59.0	.449	.550	.479	.96	.71	.95	E b s	E b s	N E b N	0.01	4.01	3.03	...	0.183	...	C. Str. 10.	Do. 4.	Rain.
23	.425	.597	.663	56.5	63.1	55.0	.432	.461	.372	.94	.79	.84	N N w	NW b w	NW b w	15.75	19.00	15.70	...	1.230	...	Rain.	Cir. Str. 8.	Cir. Str. 10.
24	.625	.714	.729	50.0	71.6	63.1	.314	.532	.461	.83	.70	.79	NW b w	NW b w	w b N	14.96	8.36	17.32	...	...	...	Clear.	Clear.	Clear.
25	.624	.622	.627	60.0	71.7	64.5	.416	.588	.504	.79	.78	.84	s w b s	w b s	N w	5.10	1.96	24.07	...	Inp.	...	C. C. Str. 6.	Cir. Str. 4.	C. Str. 4. D. Th.
26	.612	.615	.701	62.0	74.8	61.5	.445	.532	.362	.79	.64	.66	N N w	N w	NW b w	0.30	8.80	9.98	...	...	...	Clear.	Clear.	Str. 4.
27	.695	.680	.812	57.0	83.3	65.0	.376	.681	.527	.79	.61	.85	N w	s w	s	0.87	4.72	1.52	...	...	...	Do.	Do.	Clear.
28	.831	.767	.779	60.6	83.4	64.6	.416	.617	.476	.79	.56	.79	E s E	s E b E	s E	2.13	3.26	0.46	...	...	...	Do.	Do.	Do.
29	.655	.608	.640	60.1	78.9	64.0	.381	.578	.476	.73	.61	.79	E	E	E N E	4.85	8.81	8.17	...	...	...	Do.	Str. 4.	C. Str. 8.
30	.709	.646	.567	63.0	64.0	57.5	.435	.476	.447	.75	.79	.93	s s E	s s E	s E b E	5.47	7.43	1.21	...	0.130	...	C. Str. 8.	C. Str. 10.	Do. 10.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—JULY, 1857.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL. D.

Latitude—45 deg. 32 min. North. Longitude—73 deg, 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32° Fahr. 6 A.M.	2 P.M.	10 P.M.	Temp. of the Air. 6 A.M.	2 P.M.	10 P.M.	Tension of Vapor. 6 A.M.	2 P.M.	10 P.M.	Humidity of Air. 6 A.M.	2 P.M.	10 PM	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Velocity in miles per hour. 6 A.M.	2 P.M.	10 PM	Mean direction of Wind.	Rain in Inches.	Snow in Inches.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0. 6 A.M.	2 P.M.	10 P.M.
1	29.670	29.712	29.846	77.3	70.0	58.0	.447	.628	.462	.94	.86	.94	S E b S	S S E	S S E	2.86	1.40	2.68	...	0.066	...	C. Str. 10.	C. Str. 4.	C. St. 8.
2	29.941	30.000	29.948	63.0	80.0	60.0	.461	.681	.467	.79	.68	.88	S S E	S by E	S	0.27	2.00	0.23	...	...	...	Do. 2.	Clear.	Do. 2.
3	.909	29.814	.728	59.0	80.0	60.8	.426	.588	.456	.84	.58	.84	W S W	S by W	S by W	0.10	2.97	1.71	...	...	...	Clear.	C. Str. 2.	Do. 2.
4	.726	.712	.862	60.5	78.9	52.0	.441	.492	.304	.84	.52	.76	W N W	W N W	N W	1.76	6.26	6.33	...	...	...	Cirr. 2.	Clear.	Clear.
5	.912	.885	.994	44.6	80.5	61.5	.241	.588	.456	.79	.58	.84	S S E	W	S W	0.07	0.06	0.07	...	...	...	Clear.	Do.	Do.
6	.883	.872	.755	50.8	85.1	66.5	.349	.628	.544	.93	.53	.85	S W	W b S	SW b S	0.01	0.22	0.67	...	...	...	C. C. Str. 4.	C. Str. 2.	Do.
7	.638	.615	.667	65.8	74.1	62.9	.499	.681	.445	.80	.82	.79	W S W	SW b W	W by E	3.13	12.20	8.91	...	...	...	Ligt. Cirri.	C. Str. 10.	Do.
8	.862	.794	.738	55.5	81.7	62.0	.331	.638	.397	.74	.61	.71	N W bW	NW b N	SW b W	7.73	1.83	8.40	...	Inapp	...	Clear.	Clear.	Do.
9	.956	.934	.968	60.9	84.5	64.4	.371	.638	.504	.71	.56	.84	S W	S W	S W	0.20	0.15	1.80	...	...	...	Do.	C. C. Str. 4.	Str. 4.
10	.853	.905	.967	60.0	85.5	68.5	.494	.692	.613	.90	.58	.85	S by E	S W	S S E	0.22	2.83	0.01	...	...	...	C. Str. 6.	C. Str. 8.	Cirr. 1.
11	.898	.885	.802	64.9	93.4	73.6	.527	.854	.628	.85	.53	.78	W S W	W S W	S W b S	0.23	0.85	4.43	...	...	...	Clear.	Clear.	ClearF.Aur.Bor.
12	.805	.744	.777	74.1	90.0	72.4	.648	.776	.670	.78	.56	.85	SW b W	W	E	0.63	0.77	1.23	...	...	...	Do.	C. St. 9.	C,C.Str.D.Thun.
13	.772	.725	.730	77.6	88.6	76.0	.681	.925	.727	.74	.71	.82	S S W	S S W	S b W	0.12	1.38	0.41	...	...	...	Fog.	C. C. St. 8.	Dis.Thun. Clear.
14	.828	.772	.697	74.0	97.6	73.4	.681	.986	.692	.82	.51	.86	S S W	S by W	S b W	0.10	2.43	0.32	...	...	...	Clear.	C. St. 6.	Clear.
15	.714	.666	.702	77.1	94.3	73.5	.648	1.136	.692	.71	.68	.86	S W	S by E	SW b W	0.22	3.13	4.40	...	...	...	Do.	C. St. 4.	C.St.4L't inNW.
16	.711	.709	.740	75.1	90.0	67.8	.670	.896	.646	.78	.65	.94	S b W	S by W	S	0.08	0.89	3.10	...	0.180	...	Do.	C. C. St. Th.	C. Str. 10.
17	.711	.704	.725	69.5	86.0	71.6	.668	.955	.715	.94	.78	.94	SE b E	W S W	NE b N	0.83	0.83	7.83	...	0.409	...	Rain.	C. St. 10.	Do. 9.
18	.666	.570	.607	66.4	92.3	73.6	.605	.896	.727	.94	.59	.90	S	W by S	S S W	0.10	0.13	1.80	...	...	...	C. Str. 9.	C. C. St. 4.	Clear.
19	.526	.518	.471	73.0	70.3	70.4	.692	.715	.715	.86	.94	.93	S W	N by W	S	1.10	3.05	4.40	...	...	...	D. S. Thunder.	Rain.	Str. 3.
20	.438	.431	.492	74.2	79.0	68.8	.715	.763	.646	.86	.78	.91	SW b W	S W b W	S by W	6.66	1.03	0.10	...	1.036	...	C. to 10.	C. St. 10.	C. C. Str. 4.
21	.476	.514	.475	66.1	73.0	67.0	.574	.327	.626	.89	.90	.94	NE byE	E S E	E N E	0.52	4.12	1.06	...	...	...	Do.	Do. 9.	Do. 4. Thunder.
22	.556	.640	.782	68.0	71.8	58.0	.650	.588	.412	.96	.78	.84	E N E	E N E	E N E	7.16	12.92	15.40	...	0.800	...	Do. 10.	Do. 4.	Do. 9.
23	.820	.826	.814	57.0	86.4	59.0	.376	.698	.478	.79	.53	.95	N EbyE	NE byE	E b N	20.56	13.70	12.56	...	...	...	Do. 10.	C C. St. 8.	Cir. Str. 10.
24	.786	.787	.747	60.7	63.5	63.0	.411	.578	.546	.84	.96	.94	E by N	NW b W	S E b E	5.47	2.07	1.48	...	1.106	...	Cir. Str. 4.	Rain.	Str. 4.
25	.812	.793	.849	62.2	81.0	68.0	.528	.739	.613	.94	.71	.89	S	W S W	S W	1.17	5.92	2.12	...	0.996	...	Cir. Str. 9.	Cir. Str. 4.	Str. 4. Thunder.
26	.882	.787	.864	69.5	89.0	70.6	.634	.868	.628	.90	.65	.86	S W bW	W S W	S W b S	5.25	7.17	2.22	...	0.170	...	Str. 2.	Do. 4.	Clear.
27	.843	.754	.704	68.6	92.0	72.7	.613	.670	.704	.89	.44	.90	S W b S	S W	S S W	0.65	2.36	0.28	...	...	...	Clear.	Do. 2.	Str. 4.
28	.557	.612	.726	75.5	79.7	66.7	.739	.628	.574	.86	.64	.89	S W b S	S W b S	S W b S	3.45	6.40	12.73	...	...	...	C. to 6.	Do. 4.	C. C. Str. 4.
29	.754	.799	.963	59.3	74.1	64.8	.478	.617	.534	.93	.74	.89	N N W	N W	S W	5.92	3.25	0.01	...	Inapp	...	Clear.	Do. 2.	Clear.
30	.947	.836	.855	62.0	83.0	64.0	.528	.617	.534	.93	.56	.89	S E	S S E	S	1.14	4.22	3.07	...	...	...	Do.	C. C. Str. 4.	Cirr. Str. 4.
31	.734	.614	.548	63.0	79.9	63.3	.516	.715	.546	.89	.71	.94	S S E	S by E	S b E	6.12	6.47	9.31	...	0.902	...	C. C. to 8.	C. St. 6.	Cirr. Str. 10.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR JUNE.

Barometer	Highest, the 21st day	29.818
	Lowest, the 11th	28.937
	Monthly Mean	29.615
	Monthly Range	0.881
Thermometer	Highest, the 10th day	85°.9
	Lowest, the 6th day	39°.2
	Monthly Mean	61°44
	Monthly Range	46°7

Greatest intensity of the Sun's Rays .... 121°.9

Lowest point of Terrestial Radiation .... 36°.1

Mean of Humidity .... .786

Amount of Evaporation 3.430

Rain fell on 16 days amounting to 6.212 inches ; it was raining 61 hours 58 minutes, and was accompanied by thunder on two days.

The most prevalent wind was the W by S.

The least prevalent wind E.

The most windy day the 23rd ; mean miles per hour 16.81.

Least windy day the 8th ; mean miles per hour 0.00.

The Aurora Borealis visible on 2 nights.

The electrical state of the Atmosphere has indicated moderate intensity.

Ozone was in moderate quantity.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR JULY.

Barometer	Highest the 2nd day	30.000
	Lowest the 20th day	29.431
	Monthly Mean	29.754
	Monthly Range	0.569
Thermometer	Highest the 14th day	98°7
	Lowest the 8th day	46°.8
	Monthly Mean	71°57
	Monthly Range	41°9

Greatest Intensity of the Sun's Rays .... 122°0

Lowest Point of Terrestrial Radiation .... 44°.6

Mean of Humidity .... .800

Amount of Evaporation 2.85

Rain fell on 11 days, amounting to 5.755 inches ; it was raining 29 hours and 57 minutes and was accompaned by thunder on 7 days.

Most prevalent wind, S. W. Least prevalent wind, E.

Most windy day, the 23rd day ; mean miles per hour, 15.60.

Least windy day, the 5th day ; mean miles per hour, 0.06.

Aurora Borealis visible on 1 night.

The electrical state of the atmosphere has indicated constant and high tension.

Ozone was in small quantity.

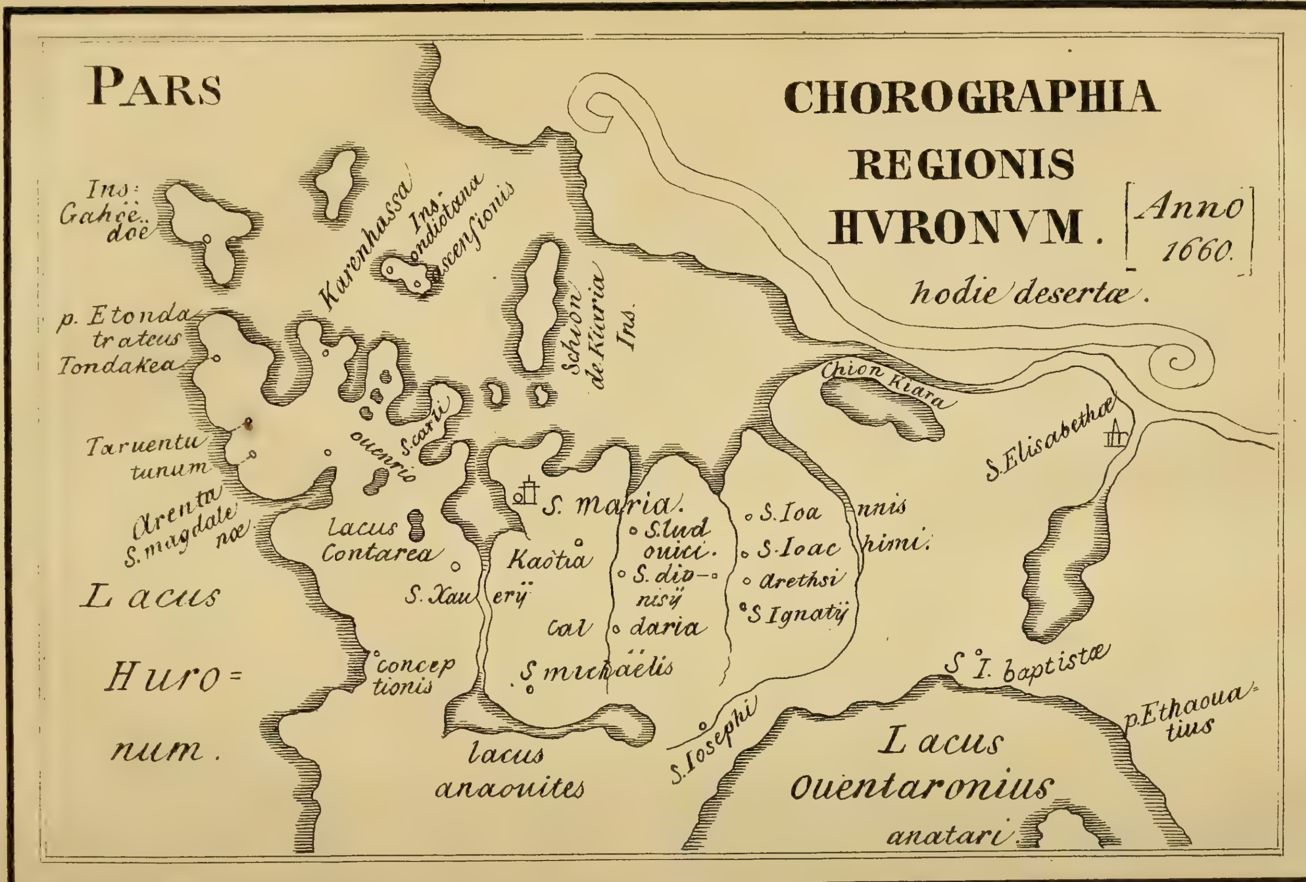
ABSTRACT OF METEOROLOGICAL REGISTER, KINGSTON, CANADA WEST, 1856.

Latitude, 44 *deg.* 13.30 *min. North. Longitude,* 76 *deg.* 30. *min. West. Height above Sea* 280 *Feet.*

1856.	Barometer at 32° corrected.		Thermom.		Thermom. during 24 hours.		Tension of Vapor.		Humidity.		Clouds.		Direction of Wind.		Pressure in lbs. avoirdupois.		Rain in inches.	Snow in inches.	Remarks.
	9 A.M.	3 P.M.	9 A.M.	3 P.M.	Max.	Min.	9 A.M.	3 P.M.	9 A.M.	3 P.M.	9 A.M.	3 P.M.	9 A.M.	3 P.M.	9 A.M.	3 P.M.			
January....	29.689	29.624	12.9	18.4	20.0	7.9	.086	.102	.786	.803	6.5	6.	N W	N W	.66	.56	....	17.0	Bay frozen over on 4th
February..	29.510	29.479	13.6	21.0	23.0	8.6	.082	.094	.744	.740	5.4	5.6	N N W	W S W	.66	.84	....	2.5	January.
March	29.582	29.561	20.9	27.5	28.3	14.8	.100	.127	.729	.759	4.9	4.7	N N W	W S W	.66	.8	....	18.0	Ice in Bay broken up
April.........	29.688	29.624	41.4	43.7	49.8	34.0	.221	.271	.803	.747	5.6	5.2	S S W	S S W	.542	.546	.86	....	on 11th April.
May	29.666	29.586	51.0	55.7	62.6	42.4	.304	.357	.776	.780	6.1	5.01	N E	S W	.492	.5	4.04	....	Steamer St. Lawrence
June.........	29.593	29.548	62.7	68.2	70.89	55.64	.447	.407	.813	.707	5.63	5.7	S W by S	S S W	.33	.38	1.84	....	went down the river
July	29.657	29.596	71.7	78.16	77.6	64.5	.600	.738	.866	.769	4.6	4 36	S S W	S W	.16	.132	1.245	....	on the 17th.
August......	29.594	29.544	66.2	71.1	72.9	60.7	.587	.629	.877	.865	5.3	6.5	S W	S S W	.28	.475	2.048	....	Steamer Kingston left
September.	29.674	29.588	58.8	64.6	67.7	52.9	.441	.509	.884	.868	5.46	5.8	S W	S W	.316	.663	4.512	....	for Toronto on the
October.....	29.748	29.724	46.7	52.1	55.0	41.2	.306	.346	.920	.909	5.0	4.5	S W	S W	.371	.37	.71	....	22nd.
November.	29.712	29.655	35.9	38.7	42.0	30.5	.207	.224	.902	.887	7.0	8.4	N W	W	.64	.8	.64	....	
December..	29.747	29.634	16.82	22.14	28.29	12.37	.099	.116	.764	.816	6.35	6.65	W N W	W	.854	1.048	.854	....	Total rain in inches
Means	29.655	29.597	41.55	46.77	49.83	35.46	.290	.331	.822	.804	5.65	5.7			.497	.592	17.905	37.5	17.905; snow 37.5, or taking 6 in. of snow, 1 in. of rain, 24.155
Gen.Means	29.	626	44.	16	42.	14		.310		.813	5.	67				.544			inches of rain.

Barometer maximum, December 18th,.. 30.526
Do minimum, December 14th,.. 28.610
Thermometer maximum, August 2nd,.. 88.5
Do minimum, February 13th, ... 18.9
Maximum wind, November 12th, ... $12\frac{1}{2}$ lbs. per square foot.
Prevailing winds S.W. in summer, N.W. and N.E. in winter.
Thunder and lightning on twelve days.

University of Queen's College, Kingston, 10th August, 1857.


PARS CHOROGRAPHIA REGIONIS HVRONVM.
Anno 1660.
hodie desertæ.
Ins: Gahœ doe
Karenhassa
Ins. ondiotana ascensionis
Schion de Kiaria Ins.
p. Etonda trateus
Tondakea
Taruentu tunum
Arenta S. magdalenæ
ouenrio
S. carii
Lacus Contarea
S. Xaueriy
S. maria.
Kaotia
cal
S. michaelis
S. Ludouici.
S. dionisiy
daria
S. Ioannis
S. Ioachimi.
arethsi
S. Ignatiy
Chion Kiara
S. Elisabethæ
S. I. baptistæ
p. Ethaouatius
S. Iosephi
Lacus Hurorum.
concep tionis
lacus anaouites
Lacus Ouentaronius
anatari.

THE CANADIAN JOURNAL.

NEW SERIES.

No. XII.—NOVEMBER, 1857.

ON THE EARLY DISCOVERIES OF THE FRENCH IN NORTH AMERICA.

BY JOHN LANGTON, M. A.,

VICE CHANCELLOR OF THE UNIVERSITY OF TORONTO.

Read before the Canadian Institute, February 14th, 1857.

I do not design in the present paper to enter into any detail respecting the whole of the discoveries of the French in North America, but in presenting to the Institute a collection of tracings from old French maps, more peculiarly relating to Western Canada, I propose to offer some remarks in illustration of them.

A very exaggerated impression has gone abroad as to the extent and accuracy of the knowledge possessed by the French of the country which they occupied, and I have more than once seen it asserted in the public prints, that they knew more of the interior than we do even now, excepting in those parts which have been actually surveyed and laid out for settlement. It is not always easy to trace the origin of such popularly received opinions, which are repeated till they become accepted, without inquiry, as acknowledged facts; but, in the present instance, the impression seems to have arisen from a series of maps, possessed by the Library of Parliament, which have been copied from those which are preserved in the various archives in France. To speak of these maps, however, as surveys, as I have heard them described, is to do them by no means justice. They make no pretensions to any such accuracy. The great majority of them, except some plans of towns and particular localities in Lower Canada, are rough delineations of the country, either from the personal observation of the explorers,

or from the description of others, giving the estimated distances and directions of rivers, lakes, and portages, which the travellers followed, with here and there an observation for latitude, which, when they are given, I have often found to be a degree or more in error. Still, most of them are interesting, as amongst the earliest records of our country, and there is no doubt that, in some sections of the Province particularly, some of them do give details, which appear no where in our published maps, and are not to be found in the records of the Crown Lands Office. This arises in a great measure from that tendency to centralization, which has always characterized the French nation. If any trader or missionary had penetrated into an unknown region, a description of it was sure, sooner or later, to find its way to the Intendant, and by him was transmitted to the Government at home; whilst with us, if an individual hunter or lumberer has obtained a detailed knowledge of a particular locality, he does not feel in any way bound to report it to Mr. Cauchon, and he would still less think of transmitting it to Downing-street. I have seen private charts in considerable detail, of the country between the Ottawa and Lake Huron, where our published maps present nothing but a blank; and I myself, nearly twenty years ago, made a map, from my own knowledge and the descriptions of hunters and others, of several chains of lakes, forming the head waters of the River Trent, which are still only partially laid down with any correctness, partly by Mr. Murray, of the Geological Survey, and partly from some exploratory lines run last year by order of the Crown Lands Department. All such rough plans have the same distinguishing feature, that the distances are very much exaggerated, especially the portages; for, when you have a heavy pack or a canoe on your shoulders, a mile assumes very formidable proportions. The same thing is observable in these French maps. The latest discovery generally is unnaturally enlarged, and though the easy observation for latitude keeps the distances from north to south within reasonable bounds, those from east to west, where there is no such check, attain very exaggerated proportions.

But it is not for the geographical information to be obtained from them, so much as for their historical interest, that I propose introducing these maps to the Institute. It must, however, be confessed that there is a great drawback to their value in this point of view, in the fact that some of them bear no date, nor is there any record accompanying them of the source from which they were obtained; but many of them possess internal evidence of their origin, and of the period to which they relate; and I have selected for copying, those which are of the most general interest, especially for us Upper Canadians, which I

will illustrate by a short sketch of the progress of French discoveries on this continent.

Although Jacques Cartier entered the St. Lawrence in the first half of the sixteenth century, it was not till the beginning of the seventeenth that any sustained effort was made towards a permanent occupation of the country. A few trading visits were made from time to time; but at the period of Champlain's first voyage, in 1603, it is doubtful whether there was any establishment even at Tadousac, where parties regularly wintered, and certainly there was nothing beyond. He proceeded up the river as far as the Sault St. Louis, now the La Chine Rapids, and having crossed the portage to obtain a view of the country beyond, he returned to France, and devoted the following years to exploring the Atlantic coast of Maine, Nova Scotia, New Brunswick and Gaspé. It was not till the year 1608 that he returned to the St. Lawrence, and built the first house at Quebec.

Champlain at once entered into friendly relations with the Indians inhabiting the northern shore of the St. Lawrence. The Montagnets, from Quebec downwards, and higher up the Algoumequins, as he designates them, who were afterwards called Algonquins, together with allied tribes of various names, from the Ottawa country, appear all to have belonged to the great Chippewa family, which still extends over nearly a quarter of the continent. He also fell in with parties of the Ochateguins, or Hurons, as they are subsequently called, their own name for themselves being Yendats, or Wyandots, according to the English pronunciation. It was this tribe apparently that Cartier had found in occupation of the island of Montreal, but their settlements were now exclusively on the great lake which the French called by their name, and they only came down to the St. Lawrence for the purposes of trade. They belonged to the same race as the Iroquois, though at that time at deadly enmity with them. With the Iroquois themselves, called by the English the Five Nations, who occupied the south bank of Lake Ontario and the upper St. Lawrence, no cordiality ever existed, to the end of the French rule in Canada.

The very next spring after his arrival, with two or three companions, Champlain joined the Algonquins and Hurons in an expedition against the Iroquois, and having proceeded up the river Richelieu to the lake which still bears his name, he defeated them near where Ticonderoga now stands. During these earlier years Champlain himself seems generally to have returned to France for the winter, but some of his party remained behind at Quebec, or at another station on the island of St. Croix, and one of them accompanied a party of Algonquins to the upper Ottawa, in exchange for an Indian, whom Champlain took with

him to France. Hearing from this man, on his return in the spring of 1612, that by the route of the Ottawa he could reach the North Sea, where the English had in the meantime discovered Hudson's Bay, he proceeded up the Ottawa, giving a very clear description of the rapids and portages, and the confluence of the Rideau, Madawaska, and other streams, and reached as far as the great Alumette Island, which was the seat of the principal Algonquin Chief in those parts. Finding, however, that he had been deceived as to the probability of reaching the North Sea, and the Indians being unwilling to accompany him farther, he once more returned to France, and spent three years there in trying to induce some of the leading nobility to take his infant colony under their patronage.

This is the period of the first maps which I have seen. They bear date 1603, 1607, and 1609; but the most extensive is that published in 1613, with the first account of Champlain's voyages. It is not amongst those which I have copied. It gives his discoveries on the Atlantic coast, on the lower St. Lawrence, and the Ottawa, and indicates the existence of a large lake, from which the St. Lawrence flows.

Immediately upon his return in 1615, he joined, with about a dozen companions in another expedition against the Iroquois, the details of which are more particularly interesting to us, not only because it gave rise to the most important of the early discoveries, but because it was the first introduction of civilized man into what is now Upper Canada. Seeing that the Iroquois were seated on the south bank of the St. Lawrence, and their chief villages were amongst those lakes and rivers south of Lake Ontario which still bear the English names for the different tribes, he took a very curious road to reach them. It must, however, be remembered, that his Indian allies had to return home to collect their forces. He ascended the Ottawa beyond the limit of his first journey, till he branched off into the chain of small lakes, which led him to the Lake of the Epicerini, or Nebicerini, as later writers call them, an Algonquin tribe, who were long celebrated for their power as sorcerers, and whose name we still preserve in that of Lake Nipissing. Descending the river which flows out of that lake, he reached the great lake of the Attagouantans, or the fresh water sea of the Hurons, which he tells us is three hundred leagues from east to west, and fifty leagues wide. Turning to the east, and coasting along the northern shore, he crossed a bay at the end of the lake (Matchedash Bay) to a fine country which was the home of the Hurons. Proceeding from village to village, the names of several of which he gives, all of them evidently situated on Matchedash Bay, and between that and Lake Simcoe, he arrived at the chief place of the tribe, which he calls Cahiagué, situated apparently

somewhere in Oro or Orillia. After remaining there for a while to collect their forces, the party carry over land for three leagues to a small lake, which is connected by a narrow place with a large one twenty-six leagues round, and crossing the large lake, which, of course, is Lake Simcoe, they make a portage of ten leagues (really about half that distance) to another lake, below which is a fall, and from whence flows a river, which, after a course of sixty-four leagues, falls into the great lake of the Entouhonerons. Champlain describes this river, the course of which they followed, as running through beautiful lakes and a fine country, formerly thickly inhabited and cultivated, but at the time of his visit entirely deserted on account of the wars. This mention of extensive cultivation amongst the Indians is somewhat foreign to our notions, but it must be remembered, that though the Algonquin tribes were a wandering race of hunters, the Hurons and Five Nation Indians are always described as cultivating the soil, and living in permanent villages ; and it is one of the hardships complained of by the missionaries, that they could rarely get any meat, but lived principally upon sagamité, with occasionally some fish. Champlain says that on their route they had five portages, some of which were four or five leagues long, whereas the only long carrying place between Balsam Lake and the Bay of Quinte is that from Mud Lake to Peterborough, about seven miles. This makes me suspect that they did not follow the course of the main river, but, being desirous of concealment, kept in the back country, and carrying over into the lakes of Belmont and Marmora, re-entered the Trent by Crow River. However this may be, they reach the Lake of the Entouhonerons, cross its eastern extremity, out of which the St. Lawrence flows, and after coasting along for some distance, leave their canoes, and make a four-days journey through the woods, crossing on their way a river, which comes from a large lake, (evidently Oneida Lake,) and so reach the village of the Iroquois, which was their destination. Being repulsed, however, and Champlain himself wounded, they retreat to their canoes, re-cross the lake, and ascend a river for twelve leagues, which, after a portage, brings them to a large lake ten or twelve leagues in extent. The description accords very well with Rice Lake, but it conveys the impression that it was not the same route by which they descended, which strengthens my conjecture as to their former course, for I know of no other large lake they could have reached in this manner, Longborough Lake lying too far out of their course. Here they remained hunting till the frost enabled them to return home over the ice. During the winter Champlain visited some tribes farther south, one of which, the Tobacco-growers, seem to have been located about Guelph ; and he had intended pushing on in the

spring to a great lake he heard of above, beyond which, he was told, the buffaloes were to be found, whose skins he saw among the Hurons; but dissensions breaking out amongst his Indian allies, he returned to Quebec by the way he came, and for the rest of his life devoted himself to the care of the colony on the lower St. Lawrence.

The oldest map in this collection will illustrate the geographical knowledge obtained by Champlain's great expedition. It bears date, indeed, twenty years later, but it contains hardly anything but what is to be found in Champlain's account. It is almost identical with the map accompanying his second publication, and is, indeed, evidently copied from it, even to the rectangular islands on Hudson's Bay, and some marks, which mean nothing as they stand here, but in the published map refer to descriptions in the body of the work. Some additions were doubtless made to their knowledge in the interval between the great expedition and the date of the publication of Champlain's journal in 1632, for the Jesuits and Recollets had established missions amongst the Huron villages; but if we may judge from Sagard's journal, in 1622 and '23, the accessions would not be very great, for, interesting as it is in other respects, the geographical details are so meagre that you can only make out that he went and returned by Lake Nipissing. As to the additions between Champlain's publication and the date of the map, they only amount to six names, which I have underscored in red ink, and I have added, instead of the bare names in other parts, numbers in red ink referring to Champlain's descriptions, of which I append a copy. So unlike the reality is this map, that at first sight one would hardly make out what it is intended to represent. Lake Huron assumes a shape as dissimilar from the truth as can well be conceived. An imaginary lake appears to the north of Lake Huron, near Sault Ste. Marie, which, as it bears the same name, probably records a misunderstood description of Lake Michigan; and Lake Erie disappears altogether, being replaced by a simple river. The latter lake was however known, as one of the missionaries to the Hurons had penetrated as far the year before the date of the map, a trace of which is found in the addition of the name *Lac des Eriés;* but the configuration given by Champlain remains unaltered, and there is nothing but a river, on which it is said there is a great fall, at which quantities of fish are carried over and stunned.

The small accession of knowledge between 1614 and 1643 is of itself negative evidence of what we know from other sources, the pause in the course of discovery which took place after Champlain's expedition. Times, indeed, were approaching which were not favor-

able to discovery. In 1629 the English took Quebec, and held the colony for some years—no great feat of valour certainly, as there were no settlements except at Quebec and Tadousac, and a missionary station at Three Rivers; and in 1622, according to Charlevoix, there were only fifty souls at Quebec, including women and children. Almost immediately after Canada had been restored to France, the Iroquois wars commenced, which for many years confined the French to the lower St. Lawrence, and ended in the almost entire extermination of their Indian allies. The missionaries, it is true, adhered nobly to their converts, and in many instances perished with them; and when the remnants retired into the Far West and the Far North, they accompanied them, and so gained some acquaintance with more remote regions; but no discovery of importance is recorded. It was not till a temporary peace was made in 1669 that the adventurous spirit of the French settlers had room to display itself, and that they penetrated into the country occupied by the Iroquois.

The second map, in point of time, belongs to this period. It bears date 1670, and records the journey of two missionaries, Dolier and Galliné, who appear to have been the first, or amongst the first, who reached Lake Huron by the route of Lakes Ontario and Erie. I have found no other account of their travels, nor are their names mentioned by Charlevoix, any more than that of M. Perray, who appears to have made a portage from somewhere near Toronto to Lake Simcoe, unless he be the M. Perrot who, about the same time, was employed in negotiating with the western tribes. A letter of the Intendant, Talon, is referred to, which may probably be amongst our MS collection—detained at Quebec upon the somewhat far-fetched excuse, that it may be wanted to elucidate some knotty point connected with the Seignorial Tenure. The missionaries appear to have been very conscientious observers, distinguishing between what they have seen themselves and what they know only by report, and for gentlemen of their sacred calling, they take an unusual interest in all that pertains to the chase. There are two noticeable features about this map. The indefinite extension of Lake Erie westward, to be found in all the maps of this period, where Hennepin, nearly twenty years later, says no one had yet penetrated, for which this sufficient reason may be given, that no such extension exists in nature; and the singular delineation of Lake Huron, where the eastern shores are not very incorrectly given, nor the western shores of Lake Michigan, but there is an entire ignoring of the great peninsula of Michigan. This is the more sur-

prising, as they appear to have penetrated beyond the Straits of Mackinaw, and one can hardly account for their knowing nothing of the opposite shore.

From this period the progress of discovery was rapid. Perrot was very succesful in his negotiations with the tribes round Lake Michigan, who, at a great gathering at Mackinaw, acknowledged the supremacy of France; and the new Governor, Count Frontenac, built the fort which long bore his name, where Kingston now stands. This was the first step which curbed the power of the Iroquois, and afforded any security to the French trade on Ontario. Other forts were soon after built at Niagara, Detroit, and on Lake Huron, which rendered French influence predominant over all the great Lakes. Important discoveries followed each other rapidly. Joliet and Marquette ascended the Outagami from Green Bay on Lake Michigan, and carrying across to the Wisconsin River, followed it down to the Mississippi, which they descended as far as the confluence of the Arkansas, when being satisfied that it flowed into the Gulf of Mexico, they returned by the way of Illinois River to the extremity of Lake Michigan. The latter route was soon after pursued by La Salle with larger means, the Mississippi was followed to its mouth, and a colony founded there.

I have copied Joliet's own map, and his letter to Frontenac giving a brief description of the newly discovered countries.* Father Marquette published a short account of their journey, with a very indifferent map, but this is the only record from Joliet himself, and he gives a pathetic relation of its conclusion; how after escaping all the dangers of a difficult and unknown navigation, amidst hostile Indians, his canoe was upset in sight of the house from which he started, two of his party, his journal and all his baggage were lost, and he brought home nothing but his life.† The inscription in red ink is apparently of a later date,

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*Accurate tracings of this and the other maps referred to, in illustration of the paper, have been deposited by the author in the Library of the Canadian Institute.

† The following letter of Joliet to Frontenac, copied from the above map, is interesting as the sole memorial he has left of his expedition:—

Monseigneur le Comte de Frontenac, Conseiller du Roy en ses Conseils, Gouverneur et Lieutenant-general pour sa Majesté en Canada, Acadie, Isle de Terreneuve et autres pays de la France septentrionale.

Monseigneur,—C'est avec bien de la joye que j'ay le bonheur aujourd-hui de vous presente cette carte, qui vous ferra connoitre la situation des rivières et des lacs sur lesquels ou navigue au travers du Canada ou Amerique septentionale, qui a plus de 1200 lieus de l'est à l'ouest. Cette grande rivière, qui porte le nom the Rivière Colbert, pour avoir esté decouverte ces derniers années 1673 and 1674, par les premiers ordres que vous me donnates entrant dans votre gouvernement de la Nouvelle France, passe au-dela des Lacs Hurons et Illinois, entre la Floride et le Mexique, et pour se decharger dans la mer coupe le plus beau pays qui se puisse voir sur la Terre. Je n'ay rien veu de plus beau dans la France que la quantité de prairies que j'y ay admirés tous les jours, ny rien d'agréable comme la diversité des bocage et des forets, ou se ceuillent des prunes, des pommes, des grenades, des citrons, des meures,

although the account of the river by which you may go to California, may have been subsequently added by Joliet himself. But the lower inscription is clearly an error, for La Salle did not reach the Mississippi by the Ohio, as there stated, but by the Illinois.

La Salle's expedition is better known perhaps than any of the former ones, from Father Hennepin's journal. I find amongst the collection of maps many relating to the Mississippi, and also several to the North-western waters running into Lake Winnepeg ; but I have confined myself more especially to Canada and shall not pursue the subject any further. I have added, however, two maps relating to this period. One, bearing the date 1688, is very rude, but it is interesting as shewing the principal settlements of the Iroquois south of Lake Ontario, which appears to have been the main object in view. The other has no date, but was evidently made a little earlier. It is clearly after 1678, as Fort Frontenac is set down, and it gives the portages by which Joliet reached, and returned from, the great River Colbert, as he calls it ; but it cannot be of much later date, as it gives the Indian name of the Salmon River, at the south-east extremity of Lake Ontario, which after the sufferings of De LaBarre's expedition in 1683 was always called la Famine, and it makes no mention of Fort Niagara, which was built in 1685. It is a well executed map upon the whole, and interesting from the full detail which it gives of the habitats of the various Indian tribes. It is melancholy to look over it, and compare it with the earliest map in this collection, which is anterior to it by only about 40 years. The Iroquois wars had told their tale in the

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et plusieurs petits fruits qui ne sont point en Europe. Dans les champs on fait lever des cailles, dans les bois on voit voler les perroquets, dans les rivières on prend des poissons qui nous sont inconnus pour leur goust, figure et grosseur.

Les mines de fer, les pierres sanguines qui ne s'amassent jamais que parmy le cuivre rouge n'y sont pas rares ; non plus que l'ardoise, le salpetre, les marbres, et moulanges et charbon de terre : pour le cuivre le plus grand morceau que j'ay veu estoit comme le poing, et tres purifié, il fut decouvert auprès des pierres sanguines qui sont beaucoup meilleurs que celles de France et en quantité. Tous les sauvages ont des canots de bois de 50 pieds le long ; pour nourriture ils ne font pas d'etal de cerfs, ils tuent des bufles qui marchent par bandes de 30 et 50, meme j'en ay compté jusques à 400 sur le bord de la rivière, et les coqs d'inde y sont si communs qu'or n'en fait pas grand cas. Ils font des bleds d'inde la plus part trois fois l'année, et tous des melons d'eau pour se rafraichir pendant les chaleurs, qui n'y permettent point de glaces et fort peu de neiges. On auroit veu la description de tout dans mon journal si le bonheur qui m'avait toujours accompagné dans ce voyage ne m'eut manqué un quart d'heure devant que d'arriver au lieu d'ou j'estois party. J'avois évité tous les dangers des sauvages, j'avois passé 42 rapides et j'estois prest de debarquer avec toute la joye qu'on pouvoit avoir du succés d'une si longue et si difficile entreprise lorsque mon canot tourna hors des dangers, j'y perdis 2 hommes et ma cassette à la veue des premieres habitations françois que j'avois quittées il y avoit presque 2 ans, il ne me reste que la vie et la volonté pour l'employer à tout ce qui il vous plaira avec toute la joye possible.

Monseigneur,

Vostre très humble et très obeissant serviteur,

JOLIET.

mean time, and where Champlain indicates populous tribes we find here only Hurons, Eries, &c., "nation detruite."

The last map relating to Upper Canada is not copied from any old map, but represents Lake Ontario as it is, with the various names which are given in different maps and descriptions to localities on its shores, and I have added to it a somewhat enlarged copy of Creuxius' topography of the Huron villages near Lake Simcoe.* There is considerable confusion in these different names. One name which is variously written as Tejajagon, Teyogagon, Terraiagon, &c., is generally placed in the neighbourhood of Toronto, but Hennepin gives a similar name to a place 17 leagues above Kingston, and one of the maps to a place on Burlington Bay. Another place called Ganaraské is apparently Port Hope, but Lahontan gives that name to Burlington Bay also. As for the names given in Creuxius's map, bearing date 1660, either to places on our shore of Lake Ontario, or to the Huron villages round Lake Simcoe, I have hardly been able to identify one of them with any name which appears elsewhere. The carrying place to Lake Simcoe does not appear to have been at Toronto, but at some place considerably to the east of it, at the Rouge perhaps, and its name with various modifications of spelling, may be called Ganatchikiagon. As for the name Toronto, in the earlier maps it is always given to Lake Simcoe, and in the Huron language seems to have meant *much* or *multitude*, but Creuxius calls Lake Simcoe Lacus Ouentaronius. I do not find Toronto applied to its present locality till a map, which illustrates the campaign which ended in Braddocks defeat in 1755, when there appears to have been a French Fort here.

The remaining map belongs to Lower Canada exclusively, and to a portion of it which, being under lease to the Hudson's Bay Company at the munificent rent of £50 a year, is hardly at all known at present. It bears date 1735, and professes to be the first map that ever was made of that region, which was the Crown domain. It is compiled by a Jesuit living at Chicoutimi, and if it is not more accurate at a distance than it is within 30 or 40 miles from his own door, the great detail into which it enters cannot be much relied upon. It is, however, a curious map, with a very flowery dedication to the Dauphin,

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*The accompanying map, engraved for the Journal from the original in Father Ducreux's *Historia Canadensis*, Paris 1664, represents the region around Lake Simcoe as laid down in 1660. Unfortunately the *narrows* which form the junction between Lake Simcoe and the little Lake Couchiching have been omitted, probably through the carelessness of the engraver, but in other respects the outlines are surprizingly accurate. The Indian names, however appear to be hopelessly corrupt and their Latin dress adds to the difficulty of identifying them. Lacus Ouentaronius may perhaps be read Ouen-tarontus in accordance with the name elsewhere assigned to Lake Simcoe.

and a Latin inscription, which I submit as a puzzle to any members of the Institute, who are curious in such things.*

There are not so many details of the discoveries in this direction, and they are not of as interesting a character. Although Tadousac was so long the most important station in Canada, it was not till 1647 that the French reached Lake St. John. In 1663 they had penetrated as far as Hudson's Bay. Tadousac was the principal site of the Indian trade, long after Quebec had become the capital of the colony, and some of the oldest missionary settlements are on the Saguenay. In Champlain's time, the island of Montreal seems almost to have vied with it as a trading place for the Indians, who followed the route of the Ottawa, and Champlain himself built a house near where the Victoria Bridge crosses, though the trading rendezvous seems to have been at the back of the island, on the Riviere des Prairies. But the Iroquois wars must have rendered such a station too insecure, as no town or fort was built there till 1641, and the Indians even from Lake Huron used to ascend the streams, which fall into the Ottawa from the North, and after a portage, used to descend the St. Maurice to Three Rivers, or the Saguenay to Tadousac. Even as late as 1670, Charlevoix tells us that there were rarely less than 1200 Indians to be seen encamped at Tadousac during the trading season ; but the ravages of the small-pox amongst the Northern tribes about that period, put an end to the trade of Tadousac and Three Rivers. Some nations were no more heard of. They were exterminated, amalgamated with other tribes, or carried their furs to the English fort on Hudson's Bay. Montreal, which was now rising into importance, became the chief seat of the trade, and Tadousac was deserted.

In tracing the history of these discoveries, one cannot but be struck with the extraordinary rapidity with which the French spread themselves over the continent, as compared with the progress of the English. The commencement of the colony may date from the foundation of Quebec by Champlain in 1608, one year after the permanent establishment of the English at Jamestown, and one year before the discovery of the Hudson River, and twelve years before the landing of the Pilgrim Fathers at Plymouth. The colonies therefore commenced nearly on equal terms, yet within 8 years the French had reached Lake Huron, whilst it was nearly a century before the English had extended to any considerable distance from the sea coast. The Iroquois wars now broke out, which for many years confined the French almost entirely to the Lower St. Lawrence, but no sooner were they brought to

* His in quam supersedimus in hoc 4ta editione ne doctiores veniant Romani et tollant nostram gentem propinante ad nauseam Baccho.

a close, or rather succeeded by a hollow truce, than the tide of discovery, which had been pent up, spread over the whole continent, and in a very few years extended to the North Sea, the Gulf of Mexico, and almost to the Rocky Mountains. Much of this difference must no doubt be ascribed to the facilities afforded by our immense chain of Lakes and Rivers, and to the character of the Indians with whom the French were brought into contact, for they never made any progress in the direction of the warlike Iroquois. Something may also be due to the missionary spirit of the Jesuits and Recollets, who penetrated in spite of dangers and privations to every tribe where there was a chance of propagating the faith, and something to the ambition of their home government, which prompted to the acquisition of new territory, whilst the British colonies were left very much to themselves. But much is still to be attributed to the national character of the settlers. The Englishman, grave and earnest, settled himself at once on his farm, and devoted any leisure he could spare to framing laws for the government of the society which surrounded him, and to enforcing them with the stringency of a man, who having strong convictions himself, is very intolerant of any body who deviates from his notion of right. He was essentially a member of a community, and rarely pushed beyond reach of his neighbours, until lack of space compelled the hive to give off a swarm. The Frenchman on the contrary, with characteristic impetuosity, leaving the cares of state to the Governor or Intendant, and questions of religion to his priest, plunged at once into the excitement and adventure which, in spite of its hardships, give such an irresistable charm to a half savage life. We find constant endeavours to check this tendency of the population to wander, and edicts which forbid the colonists, even on pain of death, to pursue their hunting excursions for more than a league beyond the settlements. But nature is stronger than laws, and the *coureurs des bois* were to be found everywhere, and often no doubt where no record of their adventures has been preserved. Only six years after Champlain's expedition, at the time when Quebec could only count fifty inhabitants, we find Sagard, whilst a missionary amongst the Hurons on Lake Simcoe, saying, that the only meat he had tasted for six months was given him by a party of French hunters. If the Celt has marked his progress on this continent by that dash and *elan* which characterizes him as a soldier, but cannot always resist long continued obstacles, the Anglo-Saxon has equally exhibited the invincible tenacity, which enables him to advance step by step in spite of difficulties, and keep what he gains.

One other remark has been suggested by these enquiries, viz., the extraordinary mutability of nations in the savage state, and the rapidity

with which one race supplants another over large areas. When Cartier arrived in the St. Lawrence he described large and permanent Indian villages at Stadacona and Hochelaga ; but little more than half a century afterwards, when Champlain visited the same localities, he apparently found few Indians about Quebec, and none permanently settled at Montreal. There may have been some exaggeration in Cartier's account, but the main fact remains, and it may probably be accounted for by the increasing power of the Iroquois, which made those places dangerous abodes, and compelled the tribes, which formerly occupied them, to retreat into the interior. Again, the country north of Lake Ontario is described by Champlain as affording signs of having been formerly extensively cultivated and thickly inhabited, but in his day it was entirely deserted, and only used as a hunting ground by the neighbouring tribes. But the country of the Ottawa, and across to the Northern shore of Lake Huron, as also the Western Peninsula, is described as full of Hurons, and of Algonquin, Ottawa, Nipissing and other allied tribes. Amongst the Hurons alone, in the limited area between Matchedash Bay and Lake Simcoe, he reckons 18 walled villages, numbering 2,000 fighting men, and Sagard puts the whole population down at 30 or 40,000 souls.* Yet, within 30 years from that time this region was also a desert, and the remnants of the former inhabitants had retreated to the Northern Lakes, and as far west as the Sioux. The Hurons indeed were almost exterminated, and the paltry remnant which had not been either destroyed or incorporated with other tribes, were collected and brought down to Quebec, where their descendants still occupy the village of Lorette. All the tribes of the Western Peninsula, and the Eries on the South shore of that Lake, seem also to have been utterly exterminated, as well as the greater part of the Illinois, and other Western tribes, and the Iroquois were dominant over all Upper Canada, and all the northern part of New York and Ohio. All this occurred without the intervention of the white man, and there has been no disappearance of a savage race since from the diseases and vices which civilization brings in its train, which has surpassed, even if it has equalled in completeness and rapidity, the desolation which the conquering

* It would not appear that this estimate can have been very greatly exaggerated, from the account given of the missionary establishments. They numbered in their most flourishing period, about 1645, 42 missionaries besides their attendants. Of these two or three only remained at the principal station of Ste. Marie, at the mouth of the Wye, five other villages were called residences, where one or two missionaries remained permanently, and the rest moved from village to village often having as many as 10 under their charge. As several of these villages are mentioned as containing from 100 to 200 cabins, and 4 or 5 families residing in each, the whole population cannot have fallen far short of 30,000.

Iroquois spread around them. They too have now nearly vanished from the scene of their former power under other influences, and may soon, like the Eries and Hurons, be remembered only by a name; but when we find such extraordinary vicissitudes occurring during the brief space, of which we have any certain record, we cease to be so much surprized at the total disappearance of the Mound Builders and other prehistoric races.

SUPPOSED PREVALENCE OF ONE CRANIAL TYPE THROUGHOUT THE AMERICAN ABORIGINES.

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Read before the American Association for the advancement of Science, at Montreal, August 17th, 1857.

Among the various grounds on which Columbus founded his belief in the existence of an undiscovered continent beyond the Atlantic, especial importance was attached to the fact that the bodies of two dead men had been cast ashore on the island of Flores, differing essentially in features and physical characteristics from any known race. When at length the great discoverer of this Western world had set his foot on the islands first visited by him, the peculiarities which marked the gentle and friendly race of Guanahanè were noted with curious minuteness; and their "tawny or copper-hue," their straight, coarse, black hair, strange features, and well-develloped forms, were all recorded as objects of interest, by the Spaniards. On their return the little caravel of Columbus was freighted not only with gold and other coveted products of the new world, but with nine of its natives, brought from the Islands of San Salvador and Hispaniola,—eight of whom survived to gaze on the strange civilization of ancient Spain, and to be themselves objects of scarcely less astonishment than if they had come from another planet. Six of these representatives of the western continent, who accompanied Columbus to Barcelona, where the Spanish Court then was, were baptised with the utmost state and ceremony, as the first fruits offered to heaven from the new found world. Ferdinand and the enthusiastic and susceptible Isabella, with the Prince Juan, stood sponsors for them at the font; and when, soon after, one of them, who had been retained

in the Prince's household, died, no doubt as to their common humanity marred the pious belief, that he was the first of his nation to enter heaven.

Such was the earliest knowledge acquired by the old world of the singular type of humanity generically designated as the Red Indian; and the attention which its peculiarities excited when thus displayed in their fresh novelty has not yet exhausted itself, after an interval of upwards of three centuries and a half. That certain special characteristics in complexion, hair, form and features, do pertain to the whole race of this continent is not to be disputed; and these prevalent characteristics were so generally noted, to the exclusion of all others, that Ulloa, and after him others of the Spanish explorers of the new world remarked: *He who has seen one tribe of Indians, has seen all.* In the sense in which this remark was first made, and by Spaniards, who knew only of Central America and the tropical region of the Southern continent, there was nothing in it to challange. But that which was originally the mere rude generalization of a traveller, has been adopted in our own day as a dogma of science; and the universality of certain homogeneous characteristics of the aboriginal tribes and nations of America, with the exception of the Esquimaux, is assumed as an established postulate for the strictest purposes of scientific induction, and has been repeatedly affirmed in the very words of the Spaniard.

Such authorities as Robertson the historian, and Malte Brun, may be classed along with the first Spanish observers, in the value to be attached to their sweeping generalizations. "The Esquimaux," says the former, "are manifestly a race of men distinct from all the nations of the American continent, in language, in disposition, and in habits of life. But among all the other inhabitants of America there is such a striking similitude in the form of their bodies, and the qualities of their minds, that, notwithstanding the diversities occasioned by the influence of climate, or unequal progress of improvement, we must pronounce them to be descended from one source."* Malte Brun, with more caution, simply affirms, as the result of a long course of physiological observations, that "the Americans, whatever their origin may be, constitute at the present day a race essentially different from the rest of mankind."† But greater importance is to to be attached to the precisely defined views of Humboldt, in so far as these are not—like those of so many other writers on this subject,

* Robertson's America, B. IV. In relation to languages, this difference between the Esquimaux and the Indians is no longer maintained.

† Malte Brun, Geog. Lib. xxv.

—a mere reproduction of the opinions of Morton. Humboldt remarks in the preface to his *Researches*: "the nations of America, except those which border the polar circle, form a single race, *characterized by the formation of the skull, the colour of the skin, the extreme thinness of the beard, and the straight glossy hair.*"

Very few and partial exceptions can be quoted to the general unanimity of American writers,—some of them justly regarded as authorities in ethnology,—in reference to this view of the nations of the whole American continent, north and south. With the solitary exception of the Esquimaux, they are affirmed to constitute one nearly homogeneous race, varying within very narrow limits from the prevailing type, and agreeing in so many essentially distinctive features, as to prove them a well defined variety, if not a distinct species of the Genus Homo. Prichard, Lawrence, Wiseman, Knox, Squier, Gliddon, Nott, and Meigs, might each be quoted in confirmation of this opinion, and especially of the prevailing uniformity of certain strongly marked cranial characteristics: but the fountain head of all such opinions and views is the justly distinguished author of the *Crania Americana*, Dr. Morton, of Philadelphia. His views underwent considerable modification on some points relating to the singular cranial conformation observable in certain skulls found in ancient American graves; especially in reference to the influence of artificial means in perpetuating changes of form essentially different from the normal type; but the tendencies of his matured opinions all went to confirm his original idea of universal approximation to one cranial type throughout the New World. In some of his latest recorded views he remarks, as the result of his examination of a greatly extended series of Peruvian crania:—"I, at first, found it difficult to conceive that the original rounded skull of the Indian could be changed into this fantastic form; and was led to suppose that the latter was an artificial elongation of a head remarkable for its length and narrowness. I even supposed that the long-headed Peruvians were a more ancient people than the Inca tribes, and distinguished from them by their cranial configuration. In this opinion I was mistaken. Abundant means of observation and comparison have since convinced me that *all these variously formed heads were originally of the same rounded shape.*"

Such are the latest views of Dr. Morton, as set forth in the posthumous paper on *The physical type of the American Indians*, contributed by him to the second volume of Dr. Schooolcraft's "History of the Indian Tribes," and edited for that work by his friend and fellow labourer, John S. Phillips. In that same final contribution to

his favourite science, Dr. Morton's matured views on the cranial type of the American continent—based on the additional evidence accumulated by him, in the interval of twelve years which elapsed between the publication of the *Crania Americana* and the death of its author,—are thus defined: "the Indian skull is of a decidedly rounded form. The occipital portion is flattened in the upward direction, and the transverse diameter, as measured between the parietal bones, is remarkably wide, and *often exceeds the longitudinal line.** The forehead is low and receding, and rarely arched as in the other races; a feature that is regarded by Humboldt, Lund, and other naturalists, as a characteristic of the American race, and serving to distinguish it from the Mongolian. The cheek-bones are high, but not much expanded; the maxillary region is salient and ponderous, with teeth of a corresponding size, and singularly free from decay. The orbits are large and squared, the nasal orifice wide, and the bones that protect it arched and expanded. The lower jaw is massive and wide between the condyles; but, notwithstanding the prominent position of the face, the teeth are for the most part vertical."† The views thus set forth by him who has been justly designated: "the founder of the American School of Ethnology,"‡ have been maintained and strengthened by his successors; and scarcely any point in relation to Ethnographic types is more generally accepted as a recognised postulate than the approximative homogeneous cranial characteristics of the whole American race. A distinction, indeed is made by Morton, and to some extent recognised by his successors, between the *barbarous*, or *American*, and the *civilized*, or *Toltecan* tribes of the continent; but the distinction, according to their own view, is arbitrary, and appears alike indefinite and unsatisfactory; unless an essential difference of race, corresponding to that which is held to separate the Esquimaux from the true *Autocthones* of America, is acknowledged to exist, whereas this is expressly denied. One of the three propositions with which Dr. Morton sums up the results borne out by the evidence advanced in his *Crania Americana* is: "That the American nations, excepting the polar tribes, are of one race and one species, but of two great families, which resemble each other in physical, but

* In this statement Dr. Morton would seem to have had in view his theoretical type, rather than the results of his own careful observations, unless he accepted as evidence the artificially abreviated and flattened skulls, and even of these his *Crania Americana* furnishes only one exceptional example, from a mound on the Alabama River, (pl. LIV.) "It is flattened on the occiput and os frontis in such manner as to give the whole head a sugar-loaf or conical form, *whence also its great lateral diameter, and its narrowness from back to front.*"

† Physical type of the American Indians. Schoolcraft's His., &c., II. p. 316.

‡ Types of Mankind. p. 87.

differ in intellectual character."* Any further difficulty, arising from physical differences, is sought to be overcome by the application of the hypothesis that "these races originated in *nations*, and not in a single pair; thus forming proximate but not identical species."† But it is not fairly grappled with by any of the writers of "the American School of Ethnology." The closest approximation to a recognition of the legitimate deduction from such contrasting cranial characteristics is made by Dr. Morton himself, where he remarks in reference to the larger cerebral capacity of the Indian in his savage state, than of the demi-civilized Peruvian or ancient Mexican: "Something may be attributed to a primitive difference of stock; but more, perhaps, to the contrasted activity of the two races." It is to be noted, moreover, that Dr. Morton distinctly recognises certain unmistakeable diversities of form into which the assumed American cranial type is subdivided. He thus remarks, in his *Crania Americana*, under the head: *General observations on the barbarous nations composing the American family*:—"After examining a great number of skulls, I find that the nations east of the Alleghany Mountains, together with the cognate tribes, have the head more elongated than any other Americans. This remark applies especially to the great Lenapé stock, the Iroquois, and the Cherokees. To the west of the Mississippi we again meet with the elongated head in the Mandans, Ricaras, Assinaboins and some other tribes." But to this, Dr. Morton superadds the further remark: "Yet even in these instances the *characteristic truncature of the occiput* is more or less obvious, while many nations east of the Rocky Mountains have the rounded head so characteristic of the race, as the Osages, Ottoes, Missouris, Dacotas, and numerous others. The same conformation is common in Florida; but some of these nations are evidently of the Toltecan family, as both their characteristics and traditions testify. The head of the Charibs, as well of the Antilles as of Terra Firma, are also naturally rounded; and we trace this character as far as we have had opportunity for examination through the nations east of the Andes, the Patagonians and the tribes of Chili. In fact, the flatness of the occipital portion of the cranium will probably be found to characterise a greater or less number of individuals in every existing tribe from Terra del Fuego to the Canadas. If their skulls be viewed from behind, we observe the occipital outline to be moderately curved outward, wide at the occipital protuberances, and full

* Crania Americana. p. 260.
† Types of Mankind. p. 276.
‡ Crania Americana. p. 65.

from those points to the opening of the ear. From the parietal protuberances there is a slightly curved slope to the vertex, producing a conical, or rather a wedge-shaped outline." These opinions are still more strongly advanced in Dr. Morton's most matured views, where he ascribes the same characteristics to the Fuegian, the Indian, the tribes to the west of the Rocky Mountains, and those which skirt the Esquimaux on the north. "All possess alike the long, lank, black hair, the brown or cinamon-coloured skin, the heavy brow, the dull and sleepy eye, the full and compressed lips, and the salient but dilated nose. The same conformity of organization is not less obvious in the osteological structure of these people, as seen in the square or rounded head, the flattened or vertical occiput, the large quadrangular orbits, and the low receding forehead;" and he goes on to reiterate the opinion that, in spite of any "mere exceptions to a general rule," the Indian of every variety "is an Indian still, and cannot be mistaken for a being of any other race." Still more, in the same final embodiment of his matured opininions, Dr. Morton affirms the American race to be *essentially separate and peculiar*, and with no obvious links, such as he could discern, between them and the people of the old world, but *a race distinct from all others.*

It is obvious that the tendency of Dr. Morton's views, as based on the results of his extended observations, was to regard the most marked distinctions in American crania, as mere variations within narrow limits, embraced by the common and peculiar type, which he recognised as characteristic of the whole continent, both north and south. In this opinion his successors have not only concurred, but they even attach less importance to the variations noted by his careful eye. Dr. Nott, for example, remarks on the peculiarities of the very remarkable brachycephalic skull taken from a mound in the Scioto valley, and figured the natural size in Messrs. Squier & Davis's *Ancient Monuments of the Mississippi Valley*:* "Identical characters pervade all the American race, ancient and modern, over the whole continent. We have compared many heads of living tribes, Cherokees, Choctaws, Mexicans, &c., as well as crania from mounds of all ages, aud the same general organism characterizes each one."†

One more authority may be quoted to show that the conclusions thus early adopted by Dr. Morton, and maintained and confirmed by his subsequent writings, are still regarded as among the best established and most indisputable summaries deduced from well ascertained data of American Ethnology. Dr. J. Aitken Meigs, the edi-

* Smithsonian Contributions to Knowledge. vol. I. pl. 47.

† Types of Mankind. p. 291.

tor of Dr. Morton's "Catalogue of Skulls," subsequent to the transference of his greatly augmented collection to the Academy of Natural Sciences of Philadelphia, remarks, in his *Cranial Chracteristics of the Races of Men*: "Through *Crania Americana*, it has long been known to the scientific world that a remarkable sameness of osteological character pervades all the American tribes from Hudson's Bay to Terra del Fuego. It is equally well known that the researches of Humboldt and Gallatin have demonstrated a conformity not less remarkable in the language and artistic tendencies of these numerous and widely scattered aborigines."*

Such, then, is the opinion honestly arrived at by Dr. Morton, as the result of extensive study and observation, accepted and confirmed by his successors, and now made the starting point from whence to advance to still more comprehensive and far-reaching conclusions. It is not necessary, therefore, to prove the universal recognition of this well known Ethnological postulate by further references to recent authorities; but there is one author, at once so distinguished among American men of science, and so peculiar from the point of view from whence he has regarded the entire question of American Ethnology, as to merit special attention. Professor Agassiz, in his *Sketch of the Natural Provinces of the Animal World, and their relation to the different Types of Man*, re-affirms the homogeneous characteristics and ethnic insulation of the American Indian on entirely novel and independent grounds. After defining the evidence on which the general opinion is based, that *the boundaries within which the different natural combinations of animals are circumscribed on the surface of the earth coincide with the natural range of distinct types of man*, he proceeds to show that America, including both its northern and southern continent, differs essentially from Europe and Asia, or Africa, in being characterised throughout by a much greater uniformity in all its natural productions, than anything which comparison enables us to trace in the old world. He then adds: "With these facts before us, we may expect that there should be no great diversity among the tribes of man inhabiting this continent; and indeed the most extensive investigation of their peculiarities, has led Dr. Morton to consider them as constituting but a single race, from the confines of the Esquimaux down to the southernmost extremity of the continent. But, at the same time, it should be remembered that, in accordance with the zoological character of the whole realm, this race is divided into an infinite

* Indigenous Races of Men, p, 332.

number of small tribes, presenting more or less difference one from another."

The latest views of Agassiz, as set forth in his contribution to the *Indigenous Races of the Earth,* present us with the same opinions, advanced with additional confirmation from other data. Passing from the general zoological analogies in the distribution of species, to the special one of the monkey, he remarks on the diversity of opinions among men of science as to the genus *Cebus*, which some Zoologists recognise as one species, others separate into two or three, while others again subdivide it into as many as ten :—" Here we have, with reference to one genus of monkeys, the same diversity of opinion as exists among Naturalists respecting the races of man. But in this case, the question assumes a peculiar interest, from the circumstance that the genus *Cebus* is exclusively American ; for that discloses the same indefinite limitation between its species which we observe also among the tribes of Indians, or the same tendency to splitting into minor groups, running really one into the other, notwithstanding some few marked differences,—in the same manner as Morton has shown that all the Indians constitute but one race, from one end of the continent to the other. . . . . . In the Old World, notwithstanding the recurrence of similar phenomena, the range of variation of species seems less extensive, and the range of their geographical distribution more limited. In accordance with this general character of the animal kingdom, we find likewise that, among men, with the exception of the Arctic Esquimaux, there is only one single race of men extending over the whole range of North and South America, but dividing into innumerable tribes ; whilst, in the Old World there are a great many well-defined and easily distinguished races, which are circumscribed within comparatively much narrower boundaries." To this may be added Mr. Gliddon's summary of the views advanced by him, in carrying out the suggestive idea of Agassiz, in the *Monogenists and Polygenists* of the former :*—"We may now reconsider, some of the practical issues of this inquiry. It has been shown, 1st. That in America, humatile men and humatile monkeys occupy the same palæontological zones. 2nd. That whilst all such remains of man are exclusively of the American Indian type, the monkeys called *Hapale, Cebus, Callithrix*, &c., are equally ' terræ geniti' of this continent. . . . . Finally, that *permanence of type*, as well for humanity as for simiadæ, is firmly established in both genera, from the hour in which we are living

* Indigenous Races of Men, p. 522.

back to a vastly remote, if not incalculable era of unrecorded time."

Such being some of the very important and comprehensive deductions now based on the premises originally advanced by Dr. Morton, it becomes of some interest to the Ethnologist to ascertain if these premises are so surely established as to be beyond all question. That some of the assumed evidence of this all-pervading conformity has been adopted on insufficient data, is manifest from the premature generalizations in relation to the holophrastic or polysynthetic character affirmed to pertain to all the languages and dialects of America, and assumed to supply the place of that grammatical unity of structure in the Indo-European languages, the establishment of which has led to such important results.

The dialects of the numerous families of American tongues multiply with the labors of their investigators. Duponceau, writing in 1822, numbered them as one thousand two hundred and fourteen. Scarcely any trace of the roots of a common vocabulary help in the comparison of many of these diverse languages of the New World. Of some of the indigenous tongues even now spoken around the Rios and Colorado, and in more southern latitudes, the holophrastic attribute is rather assumed than known; and in more than one group, of which the Carib is an illustration, languages are found in nearly the lowest stages of undeveloped simplicity. Nevertheless, this holophrastic or polysynthetical mode of condensing a group of words into one abreviated term susceptible of further modification, and of inflexion, is well worthy of the interest it has excited. This distinguishing trait, or "plan of thought of the American languages," as Dr. Lieber has designated it, has yet to be applied as a philological test to many untried tongues and dialects of the new continents; but meanwhile some of the most comprehensive generalizations based on it seem to have been advanced in the inverse ratio of the linguistic knowledge of their advocates. Those most fitted to pronounce on the subject—as Duponceau, in his later writings, and Gallatin—most cautiously avoid general conclusions, such as the former was tempted to by earlier and less complete observations; and, as in many other inquiries, extended knowledge tends at present to complicate the question, instead of confirming the seductive theory of Duponceau, of a common philological character pervading the languages of America from Greenland to Cape Horn.

The extreme interest which attaches to the investigation of the distinguishing traits already recognized as pertaining to the languages

of the New World, cannot be over estimated, though it is not improbable that an exaggerated value has been assigned to the significance of their specialities. In more than one trait characteristics are recognized common both to Polynesian and African idioms; and further consideration suggests the probability that the special synthetic tendency pertains fully as much to an immature stage of development of these languages, as to any specific individualizing feature born of the New World's insulation. As, moreover, the opinion advanced by Gallatin, after mature investigation, of the correspondence of the Esquimaux language to those of the true Indians of America, in the same degree that these possess elements in common, is acknowledged to be correct: the assumed philological unity of the American Indians amounts to no more than a predominance of certain linguistic tendencies analogous to such as, in the Old World, embrace widely varied ethnic and geographic areas. "Physically," says Latham, "the Eskimaux is a Mongol and Asiatic; philologically he is American, at least in respect to the principles upon which his speech is constructed."*

The same manifestation of a predisposed tendency to shape the evidence to a foregone conclusion, or to assume as special whatever varies from the Normal type, may be traced in various other lines of argument; such as, for example, where, in proof of the essential ethnic difference between the Esquimaux and the true Indian of America, the traveller Herne is quoted as stating that "the Indian tribes who are their proximate neighbours on the South, once excused an unprovoked massacre of Esquimaux men, women and children, by asserting that they were a people of a different nature and origin from themselves." Such a line of argument would prove other tribes, besides the Esquimaux, to be of a different nature and origin. Similar evidence, indeed, might suffice to show that the Anglo-Saxons of the ancient Kingdom of Northumbria, so soon as they were separated by the political boundary line of the Sark or Tweed, became essentially different races; for assuredly no Indians and Esquimaux could manifest more deadly hatred to each other than that which intensifies the wild vigor of the old Border Minstrelsy.

But it is not necessary to go beyond the American pale for similar evidences. The Guanches, discovered by Columbus in 1492, attracted his attention by their gentle manners and inoffensive habits, and from them he learned of the Caribs, a fierce and warlike people

* Varieties of Man, p. 290.

of neighbouring islands and the mainland, of whom they lived in constant dread, and who subsequently became familiar to the Spaniards as a ferocious, crafty and revengeful race, delighting in cannibalism.

Moreover, the great Admiral failed not to note the marked distinction between the fair complexion of the Guanches and the reddish olive of the ferocious Caribs. Both Humboldt and Morton acknowledge the existence of considerable varieties in colour and complexion, from nearly white to a dark brown. The latter writer, indeed—guarding against possible deductions from such an admission, adverse to his favourite theory of a universally predominating conformity in all the essential characteristics of the American aborigines—adds : " These differences in complexion are extremely partial, forming mere exceptions to the primitive and national tint that characterises these people from Cape Horn to the Canadas The cause of these anomalies is not readily explained; that it is not climate, is sufficiently obvious ; and whether it arises from partial immigrations from other countries, remains yet to be decided."*

The stronghold, however, of the argument for the essential oneness of the whole tribes and nations of the American continents, is the supposed uniformity of physiological, and especially of physiognomical and cranial characteristics : an ethnical postulate which has not yet, so far as I am aware, been called in question.

On first visiting the American continent, and enjoying the opportunity of judging for myself of the physical characteristics of the aboriginal race of the forests, I did so under the full conviction of meeting with such a universal approximation to the assumed Normal type, as would fully bear out the deductions of previous observers, and especially of one so persevering in the accumulation of the requisite materials on which to base a legitimate result, as the author of the *Crania Americana*. I visited Philadelphia with a special view to examine the valuable collection of Crania formed by Dr. Morton, and looked with lively interest on some of the most striking illustrations which it affords, of the typical form assigned by him to the American race. Unfortunately, at that period, (September, 1853,) extensive alterations in progress on the buildings of the Academy, deprived me of the opportunity for such detailed observations as were requisite for drawing any just comparison between these data and the comprehensive deductions founded on them by their collector. When, therefore, I proceeded more recently to open some Indian graves in Canada, and to endeavour to procure crania from others on

* Crania Americna, p. 70.

ascertaining of their disturbance, it was solely with a view to possess myself of one or two specimens of the peculiar American type of cranium, which possessed a special interest to me from its approximation to the ancient brachy-cephalic skull, familiar to me, as found in one important class of early British barrows. It was accordingly, simply with a sense of disappointment that I found the results of repeated efforts, in different localities, supplied me with crania, which, though undoubtedly Indian, exhibited little or no trace of the rounded form, with short longitudinal diameter, so strikingly apparent in the ancient crania of Central America and the Mounds. Appreciating, as I did, the invaluable labours of Dr. Morton—which will be more fully prized, as the important science they tend to elucidate commands a wider attention and more careful study—it did not occur to me at first to question any of the results so frequently reiterted by him, and repeatedly confirmed by the concurrence of later writers. Slowly, however, the idea has forced itself upon me that, to whatever extent the affirmed typical form of the American cranium is found to prevail in other parts of the continent, the crania most frequently met with along the north shores of the great lakes, are deficient in some of its most essential elements.

In order to institute such a comparison as will satisfacto test this question, it is necessary to define the essential requisites of the American type of cranium; for, neither Dr. Morton, nor his successors, have overlooked the fact of some deviation from the supposed normal type, not only occurring occasionally, but existing as a permanent characteristic of certain tribes, including those to which I have more particularly to refer. Dr. Morton, as has been already shown, recognized a more elongated head as pertaining to certain tribes, of which he names the Lenapé stock, the Iroquois, and the Cherokees, to the east of the Alleghany Mountains; and the Mandans, Ricaras, and Assinaboins, to the west. But such elongation he speaks of as a mere slight variation from the more perfect form of the normal skull; and he adds: "even in these instances the characteristic truncation of the occiput is more or less obvious."* So also Dr. Nott, after defining the typical characteristics of the American cranium, remarks: "Such are more universal in the Toltecan than the barbarous tribes. Among the Iroquois, for instance, the heads were often of a somewhat elongated form, but the Cherokees and Choctaws, who, of all barbarous tribes, display greater

* Crania Americana, p. 69.

aptitude for civilization, present the genuine type in a remarkable degree. My birth and long residence in Southern States have permitted the study of many of these living tribes, and they exhibit this conformation almost without exception. I have also scrutinized many Mexicans, besides Catawabas of South Carolina, and tribes on the Canada Lakes, and can bear witness that the living tribes everywhere confirm Morton's type."*

We cannot err in taking the very interesting cranium found by Dr. Davis and Mr. Squier in a mound in the Scioto Valley, Ohio, as an example of the true typical head; for it is produced as such by Dr. Nott, in the "Types of Mankind," and is described, in the words of Dr. Morton, in Dr. Meigs's *Catalogue of Human Crania, in the collection of the Academy of Natural Science of Philadelphia*, issued during the present year by order of the Academy, as: "an Aboriginal American ; a very remarkable head. This is, perhaps, the most admirably-formed head of the American race hitherto discovered. It possesses the national characteristics in perfection, as seen in the elevated vertex, flattened occiput, great interparietal diameter, ponderous bony structure, salient nose, large jaws and broad face. It is the perfect type of Indian conformation, to which the skulls of all the tribes from Cape Horn to Canada more or less approximate." As shown by the front view of this skull it presents no trace of pyramidal conformation.

Of this skull the measurements which involve the most essential typical elements, and so furnish precise materials for comparison, are :—

Longitudinal diameter	6.5	inches.
Parietal "	6.	"
Vertical "	6.2	"
Intermastoid Arch	16.	"
Horizontal circumference	19.8	"

So that, in fact the cranium very closely corresponds in its measurements, in length, breadth, and height. Still further it may be noted, on examining the full sized view of the skull, as given by Messrs. Squier and Davis (Pl. XLVII.) that the singular longitudinal abreviation of this skull is nearly all posteriorly. A line drawn through the meatus auditorius externus in profile, parallel to the elevated forehead, divides it into two unequal parts, of which the anterior and posterior parts are nearly in the ratio of two to one. To this type the Ancient Peruvian and Mexican crania unquestionably approximate. Of one of the former, from the Temple of the Sun,

* Types of Mankind, pp. 441.

Pl. XI.) Dr. Morton remarks: "A strikingly characteristic Peruvian head. As is common in this series of skulls, the parietal and longitudinal diameters are nearly the same," viz., longitudinal diameter 6·1, parietal diameter 6. So far, therefore, as such evidence goes it appears to justify the conclusion arrived at by Dr. Morton, that the people represented by the Mound skulls in his possession, "were one and the same with the American race, and probably of the Toltecan branch."*

The conformity affirmed to exist between the ancient Mexican and Peruvian skulls, and those of the modern barbarous tribes, may also be so far asserted as a partial approximation in relation to some of them, and appears to receive a fuller confirmation when carefully selected examples are referred to; as a sufficient number occur to indicate the occasional reappearance of some of the most striking typical peculiarities. Such reappearance of the extremest typical forms is not, however, peculiar to this continent. I possess measurements of a singular modern (female) skull in the collection of Dr. Struthers of Edinburgh, which reproduces in all its strongest features the ancient British brachy-cephalic head; and I have in view more than one living illustration of the same sort:—one, for example—a gentleman of education and intelligence—with such an elevation of the vertex, flattened occiput, and short longitudinal diameter, as, judging by the eye, would more nearly approach the measurement of the Scioto Mound Cranium, than that of any living Indian I have seen.

Of a similar nature is the correspondence pointed out by Dr. Nott† between the Scioto mound skull and that of a Cherokee Chief who died a prisoner near Mobile in 1837. In this example, in so far as can be judged from the comparison of both by drawings in profile without precise measurements, the points of agreement are indisputable, though even here amounting to no more than an approximation. The vertical occiput of the ancient skull—more markedly vertical in the original drawing than in the small copy,—is only partially represented in the other; the square form of the ancient profile in the coronal region, becomes conoid in the modern one; and the intersecting line drawn perpendicularly through the meatus shows a very partial reproduction in the modern example, of the remarkable preponderance of posterior cerebral development, which—if not produced by artificial means—is the most singular characteristic of the ancient head.

* Crania Americana, p. 229.
† Types of Mankind, p. 442.

But while acknowledging such approximation of the selected modern Cherokee cranium to the ancient type, neither the legitimate deductions following from this, nor from the other examples referred to by Dr. Nott, appear to bear out his conclusions, that not only that type "is found among tribes the most scattered, among the semi-civilized and the barbarous, among living as well as among extinct races;" but "that *no foreign race has intruded itself in their midst, even in the smallest appreciable degree.*" The examples of Cherokee heads referred to in the *Table of Anatomical Measurements* in the Crania Americana, in so far as they fairly represent the cranial characteristics of this tribe or nation, seem to indicate that the Mobile Chief is an exceptional case; and this is further borne out by the special example selected by Dr. Morton, and figured in his great work; "The head of a Cherokee warrior who was known in the army by the name of John Waring." The following are its most characteristic measurements, exhibiting such a wide divergence from the normal type, as illustrated in that of the Scioto Mound, as to substitute contrast for comparison:—

Longitudinal diameter	7.2
Parietal "	5.3
Vertical "	5.3
Intermastoid Arch	14.1
Horizontal circumference	19.1

In the typical head the longitudinal, parietal, and vertical diameters closely correspond; in this the excess of the longitudinal over the parietal and vertical diameters is such as is rarely exceeded in the modern Anglo-Saxon, or even the longer sub-celtic head. Yet, that such an excess in the longitudinal diameter did not present to the experienced eye of Dr. Morton any striking deviation from the form of the modern Indian head is proved by his noting of this very example: "Nor is there anything remarkable in the form of the skull."

Bearing in remembrance then, the partial nature of the approximation so far apparent between the ancient and modern American cranium; personal observation leads me to believe that such is to be found—with exceptional instances of closer affinities, and also with important divergencies from the typical Indian form and character, not exceptional, but pertaining to the whole nation,—among the still numerous examples of the Algonquin stock, as represented by the Chippeways. Of these I have examined, and compared by the eye, many at widely scattered locations: on Lake Simcoe and the Georgian Bay; at Mackinaw in Lake Huron, and at Sault St. Marie; at

Ontonagon, La Point, the Apostle Islands, and the St. Louis River, on Lake Superior; as well as such chance opportunities as occur in the nighbourhood of Niagara Falls, and on the streets of our Canadian towns and villages. Physiognomically they present the wide and prominent mouth, high cheek-bones, and broad face, so universally characteristic of the American Indian; but they by no means present in a remarkable degree the wide and massive lower jaw, which has been noted as of universal occurrence among the Red Indians. Still more noticeable is the absence of the aquiline nose, so characteristic generally of the true Indian in contradistinction to the Esquimaux. The eye may be fully depended on for physiognomical characteristics; it is of much less value in testing variations from any assumed cranial type, especially in reference to comparatively minute divergencies of measurement. Nevertheless, their heads appear to me, to be of short longitudinal diameter, as compared with those of other tribes in part displaced by them; but—in so far as may be judged from the observation of the living head covered with the thickly matted and long coarse hair of the Indian, —they are not remarkable for vertical elevation.

It is by no means an easy thing to obtain actual measurements of Indans' heads. I have found an Indian not only resist every attempt that could be ventured on, backed by arguments of the most practical kind; but on the solicitation being pressed too urgently, he trembled, and manifested the strongest signs of fear, not unaccompanied with anger, such as made a retreat prudent. In other cases where the Indian has been induced to submit his head to examination, his Squaw has interfered and vehemently protested against the dangerous operation. The chief object of dread seems to be lest thereby the secrets of the owner should be revealed to the manipulator; but this rather marks the more definite form of apprehension in the mind of the christianized Indian. With others it is simply a vague dread of power being thereby acquired over them; such as Mr. Paul Kane informs me frequently interfered to prevent his taking the portraits of the Indians of the North-west, unless by stealth.

The following table presents the results of an examination of six pure-breed Chippeways, at the Indian reserve on Lake Couchiching; with the addition of two others, the only examples of the same nation, given by Morton, in the *Crania Americana.* From these it will be seen that, while in the majority of them a certain approximation of the longitudinal to the parietal diameter is discernible, it is of a very partial nature, except in one instance (No. 5) where a manifest

correspondence to certain relative proportions of the Mound-builder type of head is apparent:

TABLE I.—CRANIAL MEASUREMENTS.—(CHIPPEWAYS.)

	Longitudinal Diameter	Parietal Diameter	Frontal Diameter	Inter-mostoid Arch.	Horizon'l Circumference.
1. Joseph Shilling............	7.5	6.1	5.6	14.4	22.9
1. James Inglesol (Kobsequan).	7.4	6.0	5.0	14.8	22.3
3. Jac. Crane (Now-keise-gwab)	7.1	6.0	5.4	15.4	22.1
4. Peter Jacobs (Pah-tah-se-ga.)	7.3	5.8	5.4	15.0	22.6
5. Jacob Shilling.............	6.9	6.0	5.1	14.7	22.0
6. William Snake	7.1	6.0	5.5	15.1	22.0
7. Crania Americana, No. 683 .	7.3	5.8	4.8	15.1	20.9
8. Crania Americana, No. 684 .	7.2	5.5	4.3	14.8	20.2

Some of the measurements in the living head are necessarily affected by the hair, always coarse and abundant with the Indian. Others again, such as the vertical diameter cannot be taken; but the mastoid processes are sufficiently prominent to leave very little room for error in the measurement of the inter-mastoid arch; and this suffices to show the very exceptional approximation of the modern Chippeway head—in so far as it is illustrated by these examples,—to the ancient type, in the proportional elevation of the vertex. In the horizontal circumference some deduction must be made for the hair, to bring it to the true cranial measurement in all the six living examples.

I have selected the Chippeways for reference here, because—taking the above measurements, along with other observations,—they appear to indicate a nearer approach to some of the assumed characteristics of the American cranial type, in this widely spread branch of the Indian stock, than is observable in other Northern races, and especially than is apparent on an examination of skulls belonging, as I believe, to the original Huron occupants of the greater part of the country around Lakes Simcoe and Couchiching, where the Chippeways more especially referred to are now settled, including Upper Canada, when first explored.

But the divergent characteristics noticeable in these, and still more in the crania of older Canadian graves, are by no means confined to those named, as a few examples will suffice to show. Such a radical divergence from the assumed normal type as has been already noted in Dr. Morton's selected Cherokee cranium, is no less obvious in

that of the Miami,—the head of a celebrated chief, eloquent, of great bravery, and uncompromising hostility to the Whites: (*Crania Americana*, p. 182.)

Longitudinal Diameter	7.3
Parietal Diameter	5.5
Vertical Diameter	5.5
Inter-mastoid Arch	14.5
Horizontal Circumference	19.8

In the example of the Potawatomies, "A skull of a genuine Potowatomie, remarkable for its capacity behind the ears:" (Ibid p. 186.)

Longitudinal Diameter	7.8
Parietal Diameter	5.7
Vertical Diameter	5.3
Intermastoid Arch	16.0
Horizontal Circumference	22.1

In that of the Blackfeet, the largest of two brought to Philadelphia by Catline, and noted by Dr. Morton for its great breadth between the parietal bones. It is also very markedly pyramidal. Nevertheless, here also the longitudinal diameter is nearly two inches in excess both of the parietal and vertical diameters: (Ibid, 202.)

Longitudinal Diameter	7.1
Parietal Diameter	5.4
Vertical Diameter	5.1
Inter-mastoid Arch	13.8
Horizontal Circumference	19.9

So also Dr. Morton says of the Menominees: "I have received a series of Menominee skulls, embracing eight specimens. They are something larger than the average of Indian crania; and although for the most part they present a *rather oval shape*, they are all marked by a gently flattened occiput." (Ibid. 179.) A reference to the Catalogue of the Morton Collection at Philadelphia discloses the important fact that of those marked by the shorter longitudinal diameter, Nos. 35, 44, and 563, are females.

Again of the Delawares he remarks: "The few Delaware skulls in my possession are more elongated than is usual in the American tribes; they are also narrower in proportion in the parietal diameter and less flattened on the occiput."

Such are some indications of data—derived from a source altogether unexceptionable in the present argument,—which seem to render it impossible to uphold the views so repeatedly affirmed, of the physiog-

nomical, physiological, and above all, the cranial unity characterizing the whole ancient and modern aborigines of the New World.

I omit, meanwhile, any reference to the characteristics ascribed by Dr. Morton to the Iroquois and Hurons or Wyandots: those tribes to whom, with the greatest probability, may be assigned the crania specially examined by me, found along the shores of Lake Ontario, the north shore of Lake Erie, and on Lake Huron. When Champlain effected permanent settlements on the Lower St. Lawrence in 1608, he found the north shores of the river occupied, below Quebec, by the Montagnets or Montagnards, and above it by the Ottawas, and other branches of the Algonquin stock. The country to the westward, constituting the great Canadian Peninsula lying between Georgian Bay, the Lakes Huron, Erie, and Ontario, was chiefly, if not entirely, in the possession of the Hurons; while the Iroquois—to whom the latter were most nearly allied in social and physical characteristics, though at deadly enmity with them,—occupied the south bank of the St. Lawrence, and had their chief villages scattered among the clustering lakes, and the rivers, on the southern shore of Lake Ontario, which they continued to occupy and cultivate till driven out or exterminated in the revolutionary wars. The Iroquois and the Huron tribes were alike distinguished from many others, and especially from the neighbouring hunter tribes of the Algonquin nations, by considerable attention to cultivation, and by living permanently in large settled villages. But the Iroquois Wars effectually arrested the progress of agriculture, and at length eradicated or drove out the Hurons from their country between Georgian Bay and Lake Ontario, where they were replaced by rude Algonquin tribes formerly lying to the north of them.

The Hurons then, and, in very modern years, the Algonquins, but more especially the former, are the occupants of the country immediately to the north of Lakes Erie and Ontario, whose remains are to be looked for in the Indian graves of this district. Of them Latham remarks: "The Iroquois and Algonkins exhibit in the most typical form the characteristics of the North American Indians, as exhibited in the earliest descriptions, and are the two families upon which the current notions respecting the physiognomy, habits, and moral and intellectual powers of the so-called Red Race are chiefly founded."* In many respects, however, they presented a striking contrast. The Algonquin stock, represented by the modern Chippeways, is only known to us as embracing rude and savage hunter tribes; and both

* Varieties of Mankind. p. 333.

physically and intellectually the Chippeways were inferior to the Iroquois and Hurons. The latter displayed a manifest aptitude for civilization. In war they repeatedly effected and maintained extensive and powerful combinations. Their agricultural operations gave proof of a systematic and continuous cultivation of the soil. Corn especially was grown to a great extent. Tobacco also was so extentensively cultivated by one of the tribes of Upper Canada as to lead to its designation by the French Jesuit Missionaries of the seventeenth century as the *Petunians*, or Tobacco Growers. Moreover, their knowledge and practice of agriculture appears to have originated independently of all European influence; and but for their fatal involvement in the struggle between the Colonists and the representatives of the mother country, there seemed a reasonable prospect of such an Iroquois civilization being developed in the western districts of the State of New York, as might have enabled these representatives of the ancient owners of the soil to share in the gradual advancement of European arts and progress instead of being trodden under heel in the march of civilization.*

Of Indian skulls dug up within the district once pertaining to the Huron or Wyandot branch of the Iroquois stock, I had observed and cursorily examined a considerable number before my attention was especially drawn to the peculiar characteristics now under consideration, owing to my repeated rejection of those which turned up, as failing to furnish specimens of the assigned typical American head. Since then I have carefully examined and measured twenty-nine Indian skulls, with the following results:

1. Only three exhibit such an agreement with the American type, as judged by the eye, to justify their classification as true brachycephalic crania. One of these (No. 11,) a very remarkable and massive skull, was turned up at Barrie, on Lake Simcoe, with, it is said, upwards of two hundred others. It differs from all the other Indian crania in exhibiting the vertical occiput so very strikingly, that, when laid resting on it, it stands more firmly than in any other position. Of the Scioto Valley cranium, Dr. Morton remarks, in reference to the occiput, "Similar forms are common in the Peruvian tombs, and have the occiput, as in this instance, so flattened and vertical, as to

* La Hontan estimated the Iroquois, when first known to Europeans, at 70,000. At the present time they number about 7,000, including those in Canada; and they still exhibit traces of the superiority which once pertained to them in comparison with other Indian tribes. The very name of a Mohawk still fills with dread the lodges of the Chippeways; and the Algonquin Indians settled on the Canadian reserves on Lake Couchiching and Rice Lake, have been known repeatedly to desert their villages and camp out in the woods, or on an island, from the mere rumor of a Mohawk having been seen in the vicinity.

give the idea of artificial compression; yet this is only an exaggeration of the natural form, caused by the pressure of the cradle-board in common use among the American nation." I think it extremely probable that further investigation will tend to the conclusion that the vertical or flattened occiput, instead of being a typical characteristic, pertains entirely to the class of artificial modifications of the natural cranium familiar to the American Ethnologist alike in the disclosures of ancient graves, and in the customs of widely separated living tribes. In this I am further confirmed by the remark of Dr. Morton, in reference to the Peruvian crania: "These heads are remarkable, not only for their smallness, but also for their irregularity, for in the whole series in my possession, there is but one that can be called symmetrical. This irregularity chiefly consists in the greater projection of the occiput to one side than the other, showing in some instances a surprising degree of deformity. As this condition is as often observed on one side as the other, it is not to be attributed to the intentional application of mechanical force; on the contrary, it is to a certain degree common to the whole American tribes, and is sometimes, no doubt, increased by the manner in which the child is placed in the cradle."* To this Dr. Morton subsequently added the further remark, in describing an unsymmetrical Mexican skull: "I had almost omitted the remark, that this irregularity of form is common in, and *peculiar to American crania*."† The latter remark, however, is too wide a generalization. I have repeatedly noted the like unsymmetrical characteristics in the Brachycepalic crania of the Scottish Barrows, and it has occurred to my mind, on more than one occasion, whether such may not furnish an indication of some partial compression, dependent, it may be, on the mode of nurture in infancy, having tended, in their case also, if not to produce, to exaggerate the short longitudinal diameter, which constitutes one of their most remarkable characteristics. In the case of the Barrie skull, there can be little doubt that the flattened occiput is the result of artificial compression, of a much more decided nature than that of the cradle-board of the papoose.

It is not undeserving of notice here, that the example selected by Cuvier, among his "crania pertaining to the four principal types of the human species," to illustrate the American race, exhibits a strikingly marked prolongation of the occiput. It is described as: "*Crâne trouvé dans une caverne, près du Village de Maïpuré près des*

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* Crania Americana, p. 115.
† Types of Mankind, p. 444.

bords de l'Orénoque; rapporté par M. de Humboldt;"* and so far suffices to indicate in how far the opinion already quoted from Humboldt's *Researches* coincides with his own independent observations.

2. In addition to what has been above remarked in reference to the probable artificial origin of the supposed typical form of occiput, assigned by Dr. Morton to the whole American race; I am struck, in the majority of the examples examined, with the total absence of any approximation to the flattened occiput. Fifteen of the crania referred to exhibit a more or less decided posterior projection of the occiput, twelve of these being markedly so, and seven of them presenting such a prolongation of it, as constituted one of the most striking features in one class of ancient Scottish crania, which chiefly led to the suggestion of the term Kumbecephale,† as a distinctive term for them.

3. The tendency to the pyramidal form, occasioned by the angular junction of the parietal bones, is apparent in the majority of the skulls examined. I have noted its occurrence more or less prominently in fourteen crania, of which five exhibit a strongly marked pyramidal form, extending to the frontal bone. In some, however, it is only slightly indicated, while in several it is totally wanting.

4. I am further struck with the frequency of the very partial projection, and in some examples the total absence of the supercilliary ridge, a characteristic which I am not aware has been noted before. In seven of the skulls carefully noted by me, this is particularly manifest, and along with their pyramidal vertex and predominant longitudinal diameter, suggest affinities hitherto overlooked, with the Esquimaux form of skull.

5. I would also note that, whereas Dr. Morton states, as the result of his experience, that the most distant points of the parietal bones are, for the most part, the protuberances, I have only found such to be the case in two out of twenty-nine Canadian skulls. The widest parietal measurement is generally a little above the squamous suture.

6. The occurrence may also be noted in several of these crania, of wormian bones of such regularity of form and position, as to constitute indications at least, seemingly confirmatory of the supposed tendency to the development of an *interparietal* or *superoccipital* bone, first pointed out by Dr. Bellamy. This, which is a permanent cranial characteristic in some of the mammalia, is regarded

* *Cuvier: Le Régne Animal. Races Humaines, planches* 1 *et* 2. *pl.* 8. *fig.* 2.

† Prehistoric Annals of Scotland, p. 109.

by Dr. Tschudi as an osteological feature peculiar to the Peruvians, and is, he affirms, traceable in all the skulls of that race.

* TABLE II.—CRANIAL MEASUREMENTS.—WESTERN CANADA, (HURONS.)

		1. Long. Diam.	2. Parie. Diam.	3. Front. Diam.	4. Verti. Diam.	5. Inter-Mast. Arch.	6. Inter-Mast. Line.	7. Occip front. Arch.	8. Do from Oc. prot. to root of nose.	9. Horiz. circumf' rence.
1	Orillia	7.5	5.7	4.5	5.6	15.6	4.2½	15.	13.	21.1
2	do	7.4	5.5	4.4	5.4	14.7	4.5	....	12.	20.6
3	Oakridges	7.6	5.5	4.7	6.	15.7	4.6	15.	13.7	21.2
4	do (Female)	6.8	4.8	4.2	5.	13.6	4.	13 2	11.3	18.9
5	Windsor	6.6	5.3	4.2	5.5	14.5	4.2	13.5	12.2	19.
6	Peterborough	7.7	5.5	4.9	5.3	15.4	4.6	15.	13.6	21.1
7	Windsor	7.	5.7	4.7	5.7	15.2	4.3	14.5	12.9	20.1
8	do	7.	5.7	4.5	5.7	16.1	4.	14.4	12.4	20.1
9	do	7.4	6.1	4.9	5.7	....	4.5	15.5	13.4	21.4
10	Penetanguishene	7.8	5.6	4.6	5.9	15.5	4.5	15.6	13.5	21.3
11	Barrie	6.6	6.4	5 2	5.3	16.	4.6	14.4	12.1	20.7
12	Burlington Bay	7.	5.2½	4.4	5.3	14.	4.	13.6	11.9	19.5
13	do do	7.6	5.6	4.4	5.4	15.2	4.2	14.9	12.9	20.9
14	Burwick	7.2	5.1	4.4	5.6	14.3	4.3	14.7	12.4	21.
15	Tecumseth	7.3	5.6	4.4	5 5	14.5	4.9	14.4	12.5	20.2½
16	do (Female)	7.2	5.2	3.9	5.	14.1	3.6	14.2½	12.9	19.7
17	do	7.9	6.	4.6	5.7	16.	3.4	16.1	14.2½	22.
18	do (Female)	7.6	5.2½	4.3	5.6	14.	4.1	14.2½	12.6	20.2
19	do (Female)	7.5	5.2	4.1	5.1	13.4	4.2	14.8	13.	20.5
20	do	7.4	5.6	4.6	5.5	15.	4.4	15.	13.6	20.9
21	do	7.6	5.4	4.2	5.7	15.1	4.4	15.3	14.	20.9
22	Owen Sound	7.	5.5	4 2	5.	13.8	4.	14.	12.2	19.8
23	do	7.3	5.3	4.2½	5.2½	14.4	4.2	14.2½	12.4	20.4
24	do	7.2	5.4	3.8	5.2½	14.5	3.9	14.2	12.	19.9
25	do	7.7	5.4	4.7	5.6	14.6	4.2	15.	13.	21.4
26	Oro	7.4	5.4	......	4.2½	15.2½	4.	14.9	12.4	20.4
27	Owen Sound	7.5	5.9	5.1	5.5	15.	4.2½	15.6	13.3	21.8
28	do	7.6	5.5	4.5	5.4	14.6	4.5	14.9	13.1	21.3
29	Oro	7.5	5.6	4.4	5.5	15.5	4.3	15.2	13.	21.4

The table of measurements of skulls procured from Indian cemeteries to the north of Lakes Erie and Ontario, (Table II.) supplies some, at least, of the elements essential to the formation of a sound judgment on the question under consideration. It embraces twenty-nine examples. To these I have added, in another table, (Table III.) the corresponding measurements of the skull of the celebrated Mohawk Chief, Joseph Brant, (Tayendanaga,) from a cast taken on the opening of his grave, at the interment of his son, John Brant, in 1852. I have also further added, from the *Crania Americana*, the Iroquois and Huron examples given there, which, it will be seen, agree in the main with the results of my own independent observations ; while a comparison of the two tables will be satisfactory to those who may, not unnaturally, hesitate to adopt conclusions, based

* Table II.—Of the crania referred to in this Table, Nos. 1 to 9 and No. 29, are in my own possession. Nos. 10, 11, in the Museum of the Canadian Institute. Nos. 12, 13, Museum of Toronto University. No. 14, Museum of Knox's College, Toronto. Nos. 15 to 21, in the collection of Dr. Hodder, Toronto. Nos. 22 to 25, Museum of Trinity College, Toronto. No. 26, in the possession of Rev. John Gray, Orillia. Nos. 27, 28, in the collection of Professor Bovell, M.D., of Trinity College, Toronto.

on the amount of evidence produced, adverse to opinions re-affirmed under such various forms by so high an authority as Dr. Morton, and adopted and made the basis of such comprehensive inductions by his successors.

TABLE III.—CRANIAL MEASUREMENTS.—SIX NATIONS.

	1. Long. Diam.	2. Parie. Diam.	3. Front. Diam.	4. Verti. Diam.	5. Inter-Mast. Arch.	6. Inter-Mast. Line.	7. Occip. front. Arch.	8. Do from Oc. prot. to root of nose.	9. Horiz. circumference.
Mohawk: Brant	7.8	6.	5.	....	15.6?	....	....	13?	22.
Oneida, Morton, No. 33	7.5	5.6	4.1	5.8	14.4	4.3	14.9	....	20.8
Cayuga, do No. 417	7.8	5.1	4.2	5.4	14.2	4.5	15.5	....	20.8
Huron, do (Fem.) No. 607	6.7	5.6	4.1	5.2	14.5	3.9	14.	....	19.2
Huron, do No. 15	7.2	5.3	4.3	5.5	15.	4.4	14.2	....	19.8
Iroquois, do No. 16	7.5	5.5	4.5	5.7	15.2	4.5	15.1	....	20.8
Iroquois, do A.N.S.	7.1	5.4	4.2	5.3	14.3	4.	14.1	....	20.

The intimate relations in language, manners, and the traditions of a common descent, between those Northern and Southern branches of the Iroquois stock, render these two tables, in so far as they present concurrent results, applicable as a common test of the supposed homogeneous cranial characteristics of the aboriginal American, in relation to the area of the great Lakes. Twenty-nine skulls, such as the first table supplies, or thirty-six as the result of both, may, perhaps, appear to be too small a number on which to base conclusions adverse to those promulgated by an observer so distinguished and so persevering as Dr. Morton, and accepted by writers no less worthy of esteem and deference. Still more may these data seem inadequate, when it is remembered that Dr. Morton's original observations and measurements embraced upwards of three hundred American skulls. But—in addition to the fact that the measurements now supplied, are only the more carefully noted data which have tended to confirm conclusions suggested by previous examinations, in a less detailed manner, of a larger number of examples—an investigation of the materials which supplied the elements of earlier inductions, will show that only in the case of the ancient "Toltecan" tribes did Dr. Morton examine nearly so many examples; while, in relation to what he designated the "Barbarous Race," to which the Northern tribes belong, even in Dr. Meigs' greatly enlarged catalogue of the Morton Collection, as augmented since his death, the Seminole crania present the greatest number belonging to one tribe, and these only amount to sixteen.

In contrast to the form of head of the true American race, Dr. Morton appends to his *Crania Americana* drawings and measurements

of four Esquimaux skulls, familiar to me, if I mistake not, in the collection of the Edinburgh Phrenological Society. In commenting on the views and measurements of these, he remarks: "The great and uniform differences between these heads and those of the American Indians will be obvious to every one accustomed to make comparisons of this kind, and serve as corroborative evidence of the opinion that the Esquimaux are the only people possessing Asiatic characteristics on the American continent." In some respects this is undoubtedly true; the prognathous form of the superior maxilla, and the very small development of the nasal bones, especially contrast with well known characteristics of the American aborigines. But having had some little familiarity in making comparisons of this kind, it appears to me, notwithstanding these distinctive points, that an impartial observer might be quite as likely to assign even some of the examples of Iroquois and other northern tribes figured in the *Crania Americana*, to an Esquimaux, as to a Peruvian, Mexican, or Mound-Builder type. Compare, for example, the vertical and occipital diagrams, furnished by Dr. Morton, of the Esquimaux crania (p. 248) with those of the Iroquois and Hurons (pp. 192-194). Both are elongated, pyramidal, and with a tendency towards a conoid rather than a flattened or vertical occipital form; and when placed alongside of the most markedly typical Mexican or Peruvian heads, the one differs little less widely from these than the other. The elements of contrast between the Hurons and Esquimaux are mainly traceable in the bones of the face: physiognomical, but not cerebral.

Taking once more their cranial measurements as a means of comparison; these, when placed alongside each other, equally bear out the conclusions already affirmed. For comparison, I select, in addition to the Scioto Valley Mound-Builder, the following, as those pointed out by Dr. Morton's own descriptions as among the most characteristic he has figured: Plate XI. Peruvian from the Temple of the Sun: "a strikingly characteristic Peruvian Head." Plate XI, C. "Here again the parietal and longitudinal diameter are nearly equal. The posterior and lateral swell of this cranium are very remarkable, and the vertex has the characteristic prominence." Of the Mexican skulls Dr. Morton remarks, of Plate XVII: "with a better forehead than is usual, this skull presents all the prominent characteristics of the American race,—the prominent face, elevated vertex, vertical occiput, and the great swell from the temporal bones upward;" and of Plate XVIII: "a remarkably well characterised Toltecan head, from an ancient tomb near the city of Mexico."

TABLE IV.—COMPARATIVE CRANIAL MEASUREMENTS.

	Longitud Diameter	Parietal Diameter	Frontal Diameter	Vertical Diameter	Int. Mastoid Arch	I. M. Line.	Occipito-frontal Arch.	Horizon Circumf.
Scioto Mound......	6.5	6.	4.5	6.2	16.	4.5	13.8	19.8
	......	......	......	.....	......	......	......	.....
Peruvian..........	6.1	6.	4.7	5.5	16.	4.5	14.1	19.5
Peruvian..........	6.	5.9	4.4	5.	15.5	4.	13.2	19.
Mexican...........	6.8	5.5	4.6	6.	15.6	4.4	14.6	19.9
Toltecan	6.4	5.7	4.5	5.4	14.6	4.5	13.5	20.2
	......	......	......	......	......	......	......	.....
Iroquois...........	7.5	5.5	4.5	5.7	15.2	4.5	15.1	20.8
Cayuga	7.8	5.1	4.2	5.4	14.2	4.5	15 5	20.8
Oneida.............	7.5	5.6	4.1	5.8	14.4	4.3	14.9	20.8
Huron	7.2	5.3	4.3	5.5	15.	4.4	14.2	19.8
	......	......	......	......	......	......	......	.....
Esquimaux	7.5	5.4	4.6	5.4	14.3	4.1	15.2	20.4
"	7.3	5.5	4.4	5.3	14.1	4.3	14.4	20.3
"	7.5	5.1	4.3	5.5	14.8	3.9	15.5	20.3
"	6.7	5.	4.4	5.	13.6	4.	13.9	18.9

If the data which this table supplies furnish any fair illustration of the cranial measurements of the different nations selected, it is scarcely possible to avoid the conclusion, that—in so far as this test is to be relied on,—if a line of separation is to be drawn, it cannot be introduced, as heretofore, to cut off the Esquimaux from all others, but must rather group the Iroquois with them, on the one side, while the Toltecans and the Mound-builders stand as the representatives of a diverse class, on the other. These examples I refer to in preference to those derived from other sources, or presented in the previous table as the result of my own observations, as they are necessarily unbiassed. They are the specimens of the very races referred to, selected or brought by chance under the observation of Dr. Morton, and included as the characteristic or sole examples in his great work. But the same conclusions are borne out by the examples obtained within the Canadian frontiers; and they seem to me to lead inevitably to this conclusion: that if crania measuring in some cases, two inches in excess in the longitudinal over the parietal and vertical diameters, and in others nearly approximating to such relative measurements,—without further reference here to variations in occipital conformation,—if such crania may be affirmed, without challenge, to be of the same type as others where the longitudinal, parietal, and vertical diameters vary only by small fractional differences, then the distinction between the *brachycephalic* and the *dolichocephalic* type of head is, for all purposes of science, at an end, and the labours of Blumenbach, Retzius, Nilsson, and all who have trod in their footsteps have been wasted in pursuit of an idle

fancy. If differences of cranial conformation of so strongly defined a character, as are thus shown to exist between various ancient and modern people of America, amount to no more than variations within the normal range of a common type, then all the important distinctions between the crania of ancient European barrows, and those of living races amount to little; and the more delicate details, such as those, for example, which have been supposed to distinguish the Celtic from the Germanic cranium; the ancient Roman from the Etruscan or Greek; the Sclave from the Magyar or Turk; or the Gothic Spaniard from the Basque or Morisco, must be utterly valueless.

For the purpose of testing the assumed predominance of one uniform cranial type throughout the whole American area south of the Arctic circle, by a comparison of measurements of ancient and modern skulls: with those of the exceptional Arctic American, the Esquimaux measurements given by Dr. Morton, have been placed alongside of the others derived from the *Crania Americana*, in table IV. Through the obliging courtesy of Dr. J. Aitken Meigs, however, I am enabled to present the following table, embracing measurements of fourteen Esquimaux skulls, with one exception, in the collection of the Academy of Natural Sciences of Philadelphia, to which they have been added since Dr. Morton's death. Seven of these, Nos. 200, 674,—679, were procured at Godhavn, Disco Island, on the coast of Greenland, by Dr. B. Vreeland, U.S.N. Five of them, Nos. 1558,—1562, were obtained from different localities and ancient graves or cairns, by the lamented Arctic voyager, Dr. E. K. Kane. No. 1563, from the Danish Settlement at Upernavick, was presented to the Academy by Dr. S. W. Mitchell; and the remaining example (A.) is added from a private source. The measurements in this table differ in some respects from the previous ones. The fractions are here sixteenths, instead of tenths. The parietal diameter in the previous tables indicates the extreme breath of the skull between the parietal bones; in this it is invariably taken between the parietal protuberances. In lieu of the mastoid processes, the meati are here selected as yielding measurements of more unvarying uniformity and precision; though they have the disadvantage of being less applicable to comparisons with the living head. Bearing these variations in view, the following table presents additional means for instituting comparisons between the Indian and Esquimaux cranium; and also supplies some valuable data for testing the characteristics of the Esquimaux skull. This Dr. Meigs describes as "large, long, nar-

row, pyramidal; greatest breadth near the base; sagittal suture prominent and keel like, in consequence of the junction of the parietal and two halves of the frontal bones; proportion between length of head and height of face as 7 to 5 . . . . forehead flat and receding; occiput full and salient; face broad and lozenge-shaped, the greatest breadth being just below the orbits; malar bones broad, high, and prominent, zygomatic arches massive and widely separated: nasal bones flat, narrow, and united at an obtuse angle, sometimes lying in the same place as the naso-maxillary processes."* The remarks of Mr. J. Barnard Davis on the last named peculiarities, are worthy of note. In the Esquimaux of the eastern shores of Baffin's Bay, he observes, the nasal bones are scarcely broader, though frequently longer than in some Chinese skulls, where they are so narrow as to be reduced to two short linear bones. "In those of the opposite, or American shores of Baffin's Bay they are very different, presenting a length, breadth, and angle of position, almost equal to those of European races, having aquiline noses." † This slight yet striking anatomical difference seems to supply a link of considerable value as indicative of a trait of physiognomical character in the more southern Esquimaux, tending,—if confirmed by further observation,—like other physical characteristics already noticed, to modify the abrupt transition assumed heretofore as clearly defining the line of separation between the contrasting Arctic and Red Indian races of the New World.

TABLE V.—CRANIAL MEASUREMENTS.—ESQUIMAUX.

A. N. S. Philadelphia.	Longitudinal diam.	Frontal diam.	Parietal Diam.	Vertical diam.	Inter-meatoid Arch.	Int meatoid Line	Occip'to frontal Arch.	Horiz. Periphery.
No. 200	7.12	4. 5	4. 6	5.12	12.10	4.3	15.12	21. 6
" 674	6.15	4. 2	4.12	5. 3	12.	4.5	14. 4	19. 6
" 675	7. 2	4.	4.10	5. 9	12.12	4.5	14.10	......
" 676	7. 8	4. 6	4.13	5. 7	13.	4.2	14.14	21.
" 677	7. 8	4. 6	4. 6	5.10	12.10	4.7	14.14	20.12
" 678	6.14	3.12	4. 1	5. 4	11.12	4.5	13.10	19.
" 679	7. 6	4. 4	4.14	5.10	12. 4	4.3	14.12	20. 8
" 1558	7.11	4. 6	4. 7	5.10	12.10	4.8	15. 2	21. 6
" 1559	7. 3	4. 4	4. 8	5. 8	12. 4	4.5	14. 4	20. 4
" 1560	7. 1	3.13	4.13	5. 4	11.12	4.6	14. 4	19. 6
" 1561	7. 1	4. 3	4.12	5. 1	12.	4.	14.	19.12
" 1562	7. 1	4.	4.12	5. 4	12. 4	4.4	14. 2	19.10
" 1563	7.	4. 5	5. 4	5. 8	12.14	4.5	14.10	20. 6
A	7. 4	4. 4	5.	5. 4	12. 6	4.1	14.12	20.

In the above table the great length and narrowness of the Esquimaux skull is abundantly apparent, with no very remarkable elevation of the crown. A comparison, however, with the corresponding

* Catalogue of Human Crania, A.N.S., 1857, p. 50. † Crania Britannica, p. 30.

measurements in Table II.—keeping in remembrance the difference in the values of the fractions,—will bear out the analogies already indicated, and add new proof that the supposed uniformity traceable throughout this continent, is no more than might fairly be looked for among nations placed to so great an extent under the operation of similar conditions of social life, and affected by so many corresponding extraneous influences.

If external circumstances or the progress of civilization, exercise any influence on physical form, a greater diversity of conformation is to be looked for in Europe than among the Indians of America, where—as in Africa—nearly the same habits and modes of life have characterised the whole "Barbarous Race," throughout the centuries during which Europe has had any knowledge of them. But, making full allowance for such external influences, it seems to me—after thus reviewing the evidence on which the assumed unity of the American race is founded,—little less extravagant to affirm of Europe than of America, that the crania every where and at all periods have conformed, or even approximated, to one type.

As an hypothesis, based on evidence accumulated in the *Crania Americana*, the supposed homogeneity of the whole American aborigines was perhaps a justifiable one. But the evidence was totally insufficient for any such absolute and dogmatic induction as it has been made the basis of. With the exception of the Ancient Peruvians, the comprehensive generalizations relative to the Southern American continent strangely contrast with the narrow basis of the premises. With a greater amount of evidence in reference to the Northern continent, the conclusions still go far beyond anything established by absolute proof; and the subsequent labors of Morton himself, and still more, of some of his successors, seem to have been conducted on the principle of applying practically, and in all possible bearings, an established and indisputable scientific truth, instead of testing by further evidence a novel and ingenious hypothesis.

Dr. Latham, after commenting on the manifest distinctions which separate the Esquimaux of the Atlantic from the tribes of the American aborigines lying to the south and west of them, as elements of contrast which have not failed to receive full justice, adds: "It is not so with the Eskimos of Russian America, and the parts that look upon the Pacific. These are so far from being separated by any broad and trenchant line of demarcation from the proper Indians or the so-called Red Race, that they pass gradually into it; and that in respect to their habits, manner, and appearance, equally. So far is this

the case that he would be a bold man who should venture in speaking of the southern tribes of Russian America, to say: *here the Eskimo area ends, and here a different area begins*."* The difference thus pointed out may be accounted for, to a considerable extent, by the diverse geographical conformation of the continent, on its eastern and western sides, which admit in the latter of such frequent and intimate intercourse as is not unlikely to lead to an intermixture of blood, and a blending of the races, however primarily distinct and diverse. The evidence presented here, however, refers to tribes having no such intercourse with the Esquimaux, and distinguished from them by many important characteristics, in manners, social habits, and external physiognomy. Nevertheless if these conclusions, deduced from an examination of Canadian crania, are borne out by the premises and confirmed by further investigation, this much at least may be affirmed: that a marked difference distinguishes the Northern tribes, now or formerly occupying the Canadian area, in their cranial conformation, from that which pertains to the aborigines of Central America and the southern valley of the Mississippi; and that in so far as the Northern differ from the Southern tribes, they approximate more or less, in the points of divergence, to the characteristics of the Esquimaux:—that intermediate ethnic link between the Old and the New World, acknowledged by nearly all recent ethnologists to be physically a Mongol and Asiatic, if philologically an American.

ON ATOMIC CONSTITUTION AND CRYSTALLINE FORM AS CLASSIFICATION CHARACTERS IN MINERALOGY.†

BY PROFESSOR CHAPMAN,

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The difficulties that beset the framing of a satisfactory classification in Mineralogy are altogether unknown in other departments of Natural Science. These difficulties originate essentially in the compound nature of minerals, or, in other words, in the apparent absence of corelation between the chemical and physical characters of these bodies. So long as we are forced to admit the existence of dimorphous substances—so long as chemistry remains unable to distinguish or

* Varieties of Man, p. 291.

† Abridged from a paper read before the Montreal Meeting of the American Association for the Advancement of Science.

individualize these—so long must the physical nature of the mineral embodiment claim to be considered, and to be considered prominently, in the classification. The time is now altogether departed when calcite and iron-spar, for example, were held to be less nearly related than calcite and arragonite.

But if this truth be now almost universally admitted, there seems to be a strong tendency in its application to make all characters subservient to two: atomic constitution on the one hand, and crystalline form on the other; and to force these into corelation, by the assumption of various arbitrary and scarcely consistent principles. I do not, of course, intend to deny the high value of these characters, considered generally; but I feel warranted in asserting that, by their arbitrary employment, to the exclusion of other considerations, many really unphilosophical groupings are so concealed under an apparently philosophical garb, as seriously to retard the proper progress of the science.

That mere agreement of crystalline form—even in minute angular measurements, planes of composition, &c.—is really in many instances of no greater value as a classification-character than similarity of hardness or lustre, is necessarily forced upon us, to cite but a single case, by the crystalline identity of borax with augite. That the identity in question may be explained, perhaps, not only here but in other cases, by reference to atomic volume, does not in any way invalidate our argument. Borax and augite, alike in crystalline form, are, when viewed as minerals, when considered in their entire relations, altogether dissimilar. Hence, if two minerals happen to exhibit the same forms and combinations, with corresponding angles, &c., they are not solely on that account to be placed in the same classification group, because, as shewn in the example just referred to, in all their other relations—their essential mineral relations—they may stand most widely apart.

Atomic constitution, on the other hand—even if we shut our eyes to the fact of its arbitrary and unsettled character—is of no greater value. Minerals may be assumed to possess, wholly or in part, the same atomic constitution, and yet be utterly opposed in habitus, in conditions of occurrence, in all in fact that constitutes their mineral embodiment. Subdivisions, consequently, founded on this principle, become most artificial. Iron pyrites, for example, is commonly considered to be represented by the formula FeS^2, whilst in magnetic pyrites and in copper pyrites we have, as one of the constituents, the compound Fe^2S^3. A sesqui-sulphide (Sb^2S^3 or As^2S^3) is also present (according to the received opinion) in the red silvers, zinkenite, &c.; but who will for a moment maintain that copper pyrites (to say nothing of magnetic pyrites) is not more closely related, in every

essential respect as a mineral, to iron pyrites, than to these latter substances. It is utterly impossible not to admit this. Nevertheless, if we blindly follow the chemical view, we are actually forced to maintain the contrary. In the well-known *Krystallo-chemische System* of Gustav Rose, for example—a system held up by many as a perfect model—magnetic and copper pyrites are not only widely separated from iron pyrites, but they are placed in the same general division with the red silvers, zinkenite, jamesonite, &c. And, in like manner, the carbonates and titaniates, the silicates and sulphates, &c., stand together, from the assumed constitution of their respective acids. Arrangements of this kind may be to a certain extent convenient, but who will venture to call them anything more. Natural classifications akin to those of the botanist and zoologist, most assuredly they are not. Although opposed to my earlier belief, I now feel confident that a satisfactory classification of minerals will never be accomplished until the mineralogist cease altogether the attempt to force his groupings into corelation with the present views of Chemistry. Let it not be forgotten, that Mineralogy has in more than one instance, when in seeming opposition to Chemistry, led the chemist to the adoption of new principles by which the harmony of the two sciences has been maintained; and hence it may be legitimately inferred that, if the mineralogist proceed fearlessly to classify the objects of his study without regard to the restrictions which Chemistry would set before him, further means of agreement will be found to reconcile any differences that may spring up from this independent method of procedure. At present, Chemistry is to the mineralogist, in many respects, a tyrant the most absolute, compelling him by its exactions to groupings in which natural analogies have not the slightest voice. If two compounds have the same representative formulæ, or if amongst binary compounds of oxygen or sulphur, for example, the basic elements happen to be isomorphous or otherwise related in the simple state, they must be placed in the same group, no matter how loudly their physical characters and general conditions of occurrence may exclaim against it. In this manner, in a mineral classification beyond comparison the most philosophical in its general features yet arrived at, we have the unavoidable union of carbonic acid gas with sassolin (hydrated boracic acid) and quartz: the three occurring together, as binary oxygen compounds, the respective bases of which (carbon, boron, silicon,) happen in the simple state to be of a kindred nature. In the system of Gustav Rose again, arsenic acid and iron-glance are placed in the same group, simply because the two are sesqui-oxygen compounds; a collocation permissible, perhaps, in the case of sesqui-

oxide of iron and arsenic acid as laboratory or chemical products, but certainly without value as regards the occurrence of iron-glance and arsenic acid in their conditions as minerals—in relation to which the following leading truth cannot be too strongly insisted on, viz.: that *chemical compounds and minerals are two and distinct;* frequently, at least, if not always so. In the vast majority of cases, the products obtained by the chemist from a given mineral are not in the same condition as that in which they existed prior to their separation, and hence are not, when properly considered, the same bodies. Allowing, first of all, that bodies in combination preserve their atomic constitution unchanged, does it necessarily follow that they preserve their actual physical conditions, or what we may call their normal state of occurrence? Carbonic acid, water, &c., if present as such in solid bodies, must evidently be present in some physical condition altogether unknown to us. Amongst simple bodies also, oxygen, chlorine, &c., may be said to follow a similar law; and hence we are not justified in reasoning upon the nature of compound bodies from the nature of their constituents when uncombined. But it may also be fairly inferred, that compound bodies in combination do not always retain the atomic constitution which they are assumed to possess in the simple state; and if so, the formulæ by which we are accustomed to represent these combinations may be absolutely false, and thus worse than valueless, because leading to groupings of an artificial and arbitrary character. When we place cinnabar in the same group with galena, or, on account of the hexagonal crystallization, in a sub-group with millerite and arsenical nickel (kupfer nickel), for example, we know that by the test of the botanist and zoologist our collocation must be pronounced a faulty one; but we defend it on the plea that these minerals are each and all simple binary combinations of a metal with sulphur or with arsenic, exhibiting the general formula RS or RAs. But then the question arises—can we be quite sure of this? And so ultimately we find ourselves obliged to confess that, after all, our knowledge is limited to the fact (if fact it really be,) of the existence in these minerals of equal atoms of base and electro-negative element. This, however, does not necessarily exact for cinnabar the formula HgS. The real formula may be $Hg^2S + HS^2$. It is true that this latter compound HgS^2 has not yet been obtained in the laboratory, but analagous compounds of silver and copper (metals considered by Kühn and other chemists to be closely related to mercury,) exist, and whilst various recognized bodies still remain unisolated, the existence of the compound in question cannot be considered entirely hypothetical. At the same time I would not be understood to deny that HgS

may not be the true formula of cinnabar, because, even if such be the case, the peculiar character of the mineral may be accounted for by the not improbable assumption, that the mercury is present in some allotropic condition, essentially different from the normal state of mercury as known to us in its isolated aspect.

In the much-studied division of the silicates, we have a further proof of the really indefinite nature of our present formulæ, and consequently of the uncertain value of the groups founded on this consideration. For example: Al^2O^3 replaces SiO^3 in certain augites and hornblendes. Also, most probably, in staurolite, sillimanite, &c., and perhaps to a certain extent in some spinels and sapphires. On the other hand it is now universally allowed, that in the generality of silicates the formulæ are often greatly simplified by placing the Al^2O^3 among the monatomic bases, FeO, MgO, CaO, &c.,—a fact brought out very prominently by Professor Dana in the last edition of his *System of Mineralogy*, and in other publications. Hence, if Al^2O^3 sometimes replace SiO^3, and sometimes replace the bases RO, there is no reason why SiO^3 should not also replace the latter in certain proportions. This granted, our present formulæ may be modified to almost any extent, and sub-groups thus obtained to suit all cases.

From these and other analogous considerations—such as will readily suggest themselves to all who have made the investigation of minerals their study—I think we may fairly admit that crystalline form and atomic composition are not alone sufficient for the foundation of a truly philosophic and satisfactory classification. Important as we may allow these characters to be, they are not all-important. The general aspect of the mineral, as indicating allotropic relations, its conditions of occurrence, and other characters, must also be allowed a certain value in the elaboration of at least our secondary groups.

ON THE DIVISION OF THE AZOIC ROCKS OF CANADA INTO HURONIAN AND LAURENTIAN.

BY SIR WILLIAM E. LOGAN, F. R. S.,
DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

Read before the American Association for the advancement of Science, at Montreal, August 13th, 1857.

The Subsilurian Azoic rocks of Canada occupy an area of nearly a quarter of a million of square miles. Independent of their stratifica-

tion, the parallelism that can be shewn to exist between their lithological character, and that of metamorphic rocks of a later age, leaves no doubt on my mind that they are a series of very ancient sedimentary deposits in an altered condition. The further they are investigated the greater is the evidence that they must be of very great thickness, and the more strongly is the conviction forced upon me, that they are capable of division into stratigraphical groups, the superposition of which will be ultimately demonstrated, while the volume each will be found to possess, and the importance of the economic materials by which some of them are characterized, will render it proper and convenient that they should be recognised by distinct names, and represented by different colors on the geological map.

So early as the year 1845, as will be found by reference to my report on the Ottawa district, presented to the Canadian Government the subsequent year, a division was drawn between that portion which consists of gneiss and its subordinate masses, and that portion consisting of gneiss interstratified with important bands of crystalline limestone. I was then disposed to place the lime-bearing series above the uncalcareous, and although no reason has since been found to contradict this arrangement, nothing has been discovered especially to confirm it; and the complication which subsequent experience has shewn to exist in the folds of the whole,—apparent dips being from frequent overtures of little value,—would induce me to suspend any very positive assertion in respect to their relative superposition, until more extended examination has furnished better evidence.

In the same report is mentioned, among the Azoic rocks, a formation occurring on Lake Temiscamang, and consisting of Siliceous slates and slate conglomerates, overlaid by pale sea-green or slightly greenish-white sandstone, with quartzose conglomerates. The slate conglomerates are described as holding pebbles, sometimes a foot in diameter, derived from the subjacent gneiss, the boulders displaying red feldspar, translucent quartz, green hornblende, and black mica, arranged in parallel layers, which present directions according with the attitude in which the boulders were accidentally enclosed. From this it is evident that the slate conglomerate was not deposited until the subjacent formation had been converted into gneiss, and very probably greatly disturbed; for while the dip of the gneiss, up to the immediate vicinity of the slate conglomerate, was usually at high angles, that of the latter did not exceed nine degrees, and the sandstone above it was nearly horizontal.

In the report transmitted to the Canadian Government, in 1848, on the north shore of Lake Huron, similar rocks are described as consti-

tuting the group which is rendered of such economic importance, from its association with copper lodes. The group consists of the same silicious slates and slate conglomerates, holding pebbles of syenite instead of gneiss; similar sandstones sometimes shewing ripple-mark, some of the sandstones pale sea-green; and similar quartzose conglomerates, in which blood-red jasper pebbles become largely mingled with those of white quartz, and in great mountain masses predominate over them. But the series is here much intersected and interstratified with greenstone trap, which was not observed on Lake Temiscamang.

These rocks were traced along the north shore of Lake Huron, from the vicinity of Sault Ste. Marie, for 120 miles, and Mr. Murray ascertained that their limit on the Lake Shore occurred near Shebahahnahning, where they were succeeded by the underlying gneiss.

The position in which the group was met with, on Lake Temiscamang, is 130 miles to the north-east of Shebahahnahning, and last year Mr. Murray, in exploring the White-Fish river, was enabled to trace the out crop of the group, characterized by its slates, sandstones, conglomerates, greenstones, and copper lodes, for sixty-five miles from Shebahahnahning to the junction of the Maskinongé and Sturgeon rivers tributary to Lake Nipissing. The general bearing of the outcrop is N.E., and an equal additional distance, in the same direction, would strike the exposure on Lake Temiscamang. In the portion which Mr. Murray examined last year, the dip appears to be about N.W., often at a high angle, while that of the subjacent gneiss is more generally S.E.; sometimes at a low angle, and in some places nearly horizontal.

To the eastward of this out-crop, Canada has an area of 200,000 square miles. This has yet been but imperfectly examined, but in so far as investigation has proceeded, no similar series of rocks has been met with in it; and it may safely be asserted that none exists between the basset edge of the Lower Silurian and the group from Shebahahnahning to the Mingan Islands, a distance of more than 1,000 miles, and probably still farther to Labrador.

The group on Lake Huron, we have computed to be about 10,000 feet thick; and from its volume, its distinct lithological character, its clearly marked date posterior to the gneiss, and its economic importance as a copper-bearing formation, it appears to me to require a distinct appellation, and a separate color on the map. Indeed, the investigation of Canadian Geology could not be conveniently carried on without it. We have, in consequence, given to the series the title of Huronian.

A distinctive name being given to this portion of the Azoic rocks, renders it necessary to apply one to the remaining portion. The only local one that would be appropriate in Canada is that derived from the Laurentide range of mountains, which are composed of it, from Lake Huron to Labrador. We have therefore designated it as the Laurentian series.

These local names are, of course, only provisional, devised for the purpose of avoiding periphrastic or descriptive titles, the use of which had been found inconvenient, and they can be changed when more important developments, proved to be the equivalents of the series, are met with elsewhere.

REVIEWS.

Essay on the Insects and Diseases injurious to the Wheat Crops. By H. Y. Hind, Esq., M.A., Professor of Chemistry at Trinity College, Toronto; to which was awarded by the Bureau of Agriculture and Statistics, the first prize. Toronto: Printed by John Lovell, 1857.

This essay,—the product of a competition for prizes recently offered by the Canadian Minister of Agriculture,—is quite as good as could have been expected, considering the circumstances under which it was produced. It is a compilation, and it could not well have been anything else; but it shows knowledge of the subject, industry, and judgment. If our farmers and country gentlemen take the trouble to examine it, they will doubtless derive much benefit from it. Some of them may, perhaps, say that it is too scientific for them and may fancy it better suited to the incipient entomologist than to the practical man; but the truth is, if any better means than we possess (which are but very imperfect) for controlling the ravages of insect pests are to be discovered, it must be through a knowledge of their nature and mode of life. Practical men have need of a certain amount of scientific knowledge, and Professor Hind gives the assistance many of them require in a clear, simple, intelligible style, without much superfluous matter. The practical suggestions are generally sound and useful, and as the reasons for them are explained, every one is enabled to form his own judgment.

The essay is not of mere temporary interest; it is a useful digest on a highly important subject, of what is to be found in various volumes, and in detached essays and observations scattered through periodicals; such as Harris' Insects injurious to vegetation, Fitch's

Essay, Kirby and Spence's Manual, &c. We are not aware that the author has availed himself of the valuable original work of Kollar, on injurious insects, which is in reality the chief source from whence the writers on this subject have derived much of their more valuable information.

Whilst the author has entitled himself to much credit for his diligence and research, we think the Minister of Agriculture may be satisfied with the working of his scheme, and may congratulate himself on having obtained for a very moderate copyright what cannot but be beneficial to the country. But where are the other prize essays? We expected to have seen all published in one volume; or at least a volume for Western Canada containing the two English essays, and one for Eastern Canada, containing the French prize essay, with a translation of Mr. Hind's. It would even, perhaps, not be lost labour to cull something for public use from the other essays, some of which the judges have named as containing valuable matter; and which even where they have the least pretension to literary merit, knowledge, or research, would doubtless, in some instances, convey a fact or opinion, which, communicated by a practical man and from patriotic motives, is not unworthy of being recorded. There may be obstacles to what we suggest, in the Bureau not claiming a right to use essays to which no prize has been awarded, in the cost of printing, and in a reasonable apprehension that increase in the quantity of matter diminishes the probability of its being made use of. But it is a pity not to secure all the benefit attainable from the labours of those who sent in their observations, some of them probably without expectation of reward, but with a desire to do what they could for the public service. It is hardly necessary to quote from Mr. Hind's essay, which will be in the hands of all who are interested in its subject. We congratulate him on the honorable distinction he has attained, and recognize with pleasure the merit of his work.

W. H.

Crania Britannica.—Delineations and descriptions of the skulls of the early inhabitants of the British Islands, together with notices of their other remains. By Joseph Barnard Davis, M.R.C.S.E., and John Thurnam, M.D. Decades I and II. London, Taylor and Francis.

In the introduction to this national work, the joint product of the zealous labours of Mr. J. Barnard Davis and Dr. Thurnam, Mr.

Davis plainly sets forth their aim, as a further effort in the same direction as "the two first permanent and beautiful superstructures" of the science of comparative cranioscopy, reared by Morton on the earlier foundations of Blumenbach. In all directions the enthusiastic students of British History are aiming to extend our vision further and more clearly into the past. Dr. Todd, Algernon Herbert, Graves, and a host of other zealous Celtic scholars, are restoring to us the most ancient native Literature of the British Isles. Kemble and Thorpe, following in the wake of Sharon Turner, with greater advantages and profounder scholarship, have thrown fresh light on the Anglo-Saxon era; Palgrave continues those labors which promise to complete the links requisite to unite in complete coherence Norman and Saxon England; and Latham, Petrie, Wright, Ackerman, Roach Smith, and other Archæologists and Philologists, extend their researches in various directions, and add new and diverse contributions to the same end. It is well, therefore, that such zealous co-adjutors as the authors of the *Crania Britannica* should be welcomed, in undertaking to add to all these one more resurrection from the ancient past, and to treat with adequate minuteness and accuracy of detail, another department of the theme which our great English Ethnologist, Pritchard, dealt with in so masterly a style.

The design aimed at in this new contribution to British Ethnology is, "to apply the study of the minuter diversities in the form of the skull to the discrimination and elucidation of the various ancient races who have dwelt in the British Islands, the forerunners, at least, if not the progenitors, of a people who may be safely assumed to occupy a place in future history, inferior to none who have preceded them. The investigation of the facts connected with these races is involved in obscurity from their remoteness in time; the want of information to be derived from the scanty notices of ancient writers, whether the consequence of imperfect knowledge, or inaccurate observation, or their use of ill-understood general terms; and especially from the fanciful speculations of learned theorists." To supply some of the desiderata thus deplored, an examination of the personal remains of the ancient people is accordingly resorted to. Their memorials of ancient arts, domestic habits, military skill, and sepulchral rites, have each and all been made to contribute their quota. Now, it is proposed to ascertain the ancient lineaments and physical characteristics of the people themselves, by means of the still enduring osseous remains of those who "swayed the rod of empire," while yet the cradle-land of Anglo-Saxondom was the seat of Celtic

and the arena of the Briton's untold history; or when the Saxon colonist was entering amid the Druid oak-glades of England, a stranger, like his hardy descendant who pioneers the way amid the primeval forests of our far-west. Morton, in his *Crania Americana*, dealt with the ethnic craniology of a very wide and nearly virgin area. From the northern Arctic circle, to where the Terra del Fuego reaches towards Antarctic snows, the American Ethnologist sought to gather his materials, and from the data thus accumulated, conclusions applicable to the two continents of the new world have been deduced. Compared with such a wide field of investigation, the little island-home of the Saxons may well seem narrow ground for exploration. But to the Ethnologist it is not so. There, amid the rudest traces of primeval arts, he seeks, and probably not in vain, for the remains of primitive European Allophyliæ. There it is not improbable that both Phœnician and early Greek navigators have left behind them evidences of their presence, such as he alone can discriminate. There unquestionably was the home of the ante-christian Celt, and of the Picts, the Scots, the Belgæ, and other races of disputed origin. There, too, the Roman not only abode for upwards of three centuries, and left enduring memorials of his presence, but his sculptured tablets still attest the introduction by him of legionary colonists, not only from Gaul, Germany, Spain, and Italy, but from Asia Minor and Africa. Colonists from almost every people who had been subdued by the Roman arms were planted among the subject Britons, and these not in indiscriminate collocation, but each nationality with its own station assigned to it, where votive inscriptions and sepulchral tablets still guide the curious explorer to classify the remains he exhumes. There, too, in that same historic soil, lie the remains of the old Scandinavian Viking, Dane and Norseman, buried with the pomp of Pagan sepulture, that still tells of his northern birth-land.

As an example of the accuracy of the data thus open to investigation: amid the beautifully executed plates of life-sized crania of ancient Britons, Caledonians and Saxons, appear also more than one of the Roman conquerors. One of these was procured from a sculptured stone sarcophagus, on the outskirts of the ancient Roman Eburacum, or English York, around which lay numerous urns, pateræ, a terra-cotta lamp, and other remains of the foreign arts of the Roman Colonist. The partially mutilated Sarcophagus, belonging to the second, or at latest, the third century of our era, and is an invaluable adjunct, alike for the purposes of the Antiqua-

ry and the Ethnologist, from its bearing an inscription, which reads :—

MEI . . . . AL. THEODORI
ANI . . OMENT. VIXIT. ANN
XXXIV. M. VI. EMI. THEO
DO : : A. MATER. E. C

Imperfect as the memorial now reaches us, there is no doubt of its general tenor. It is the dedication by the Roman Matron Theodora, to the memory of her son, Theodorianus, who died at the age of thirty-four, in that remote outpost of the empire, far from Nomentum, his Latian or Sabine home. The skull of Theodorianus is a fine example of the old Roman cranium. Dr. Thurnam remarks of it:—"It is unusually capacious, and its dimensions are much above the average in almost every direction." The deductions from this single skull well illustrate how far such materials may contribute to the recovery of minute and accurate knowledge in the hands of a cautious and experienced observer. The fine aquiline profile is still discernible, slightly marred by a partial prognathic character in the jaws and position of the teeth. The uneroded crowns of the latter suffice to show the nature of the diet, and the civilized habits of the old Roman, in contrast to those of the native Britons of his age. Still further the condition of the sutures, and of the internal surface of the skull, suggest the habits of the soldier, who had not passed through the ordeal of war without sharing freely in its dangers.

"There is conclusive evidence in this noble cranium of Theodorianus," says Mr. Davis, "—the like of which we by no means anticipate meeting with in the further course of our labours,—that he was a fine Roman, of tall stature, over whose premature decease a tender mother might naturally grieve with a deep sorrow. His native country was near the imperial city itself, his family, without doubt, of consequence, and his residence in Britain possibly connected with the command of the legion which garrisoned Eburacum for so many years."

In dealing with the sepulchres of the old Briton or Saxon, the Ethnologist cannot, as with the Roman, quote the inscription which records the name and age, the birth place, and the race of the owner. But other and scarcely less intelligent records supply its place. In the *Crania Britannica* there are accordingly introduced, along with the beautifully executed cranial illustrations, other plates, besides wood cuts, which show unmistakeably the very diverse character of the sepulchral disclosures which establish the evidence of

ownership in the old burial mounds and cists of the British Isles. Here are engraved the primitive cinerary urns and domestic pottery from the ancient British Barrows of Staffordshire and Derbyshire, and the rude stone cist of Juniper Green, near Edinburgh. The flint implement of Ballidon Moor Barrow, tells of the rudest barbarism of Britain's primeval night; while at the same time such sepulchral architecture as the Gloucestershire chambered and galleried tumulus of Uley, the Derbyshire cist and megalithic mound of Parsley Hay Low, or the cist and superincumbent urn-chamber of Ballidon Moor, reveal the mode of thought of an era, analogous in its constructive ideas to that which gave birth to the pyramids and catacombs of the Nile valley. Another era succeeded, of the arts of which, the bronze dagger of End Low Barrow, Derbyshire, and the horse furniture, glass beads, and personal ornaments of the Yorkshire Barrows, furnish striking illustration; and then we come to the Iron umbos and spearheads, and the ponderous sword, of the Saxon Graves of Salisbury and Gloucester, the situla and cinerary urns of Linton Heath, Cambridgeshire, and with these the curiously ornamented glass vase, the fibulæ, and the toilet implements of Saxon times. Between the first and last of these, the era of Theodorianus intervenes, with the sculptured and inscribed Sarcophagi, the classic pottery and other intruded foreign arts of Roman Yorkshire; and, later than all, the Dane and Norseman tell, by Runic inscriptions and sepulchral hoards of the implements and the weapons of Northern Europe, how another, and yet another wave of colonization, mingled the diverse races of Europe with the elder colonists of the British Isles.

Such is the rich field of Ethnological research which Dr. Thurnam and Mr. Davis have undertaken to explore and to illustrate, with the added feature of accurate and critical descriptions and drawings of the osteological remains. The work is to be published in six "Decades," of which two only have appeared, embracing as yet incompleted chapters, and partially apportioned illustrations to some of the completed descriptions. Some of the most important questions that have recently attracted the attention of British Ethnologists and Archæologists, are expressly reserved for discussion at the close, and even of those which may be assumed to be completed, such as the interesting and suggestive one from the pen of Mr. Davis, on "Distortions of the Skull," it is to be anticipated that further illustrations may incidentally occur during the progress of the work. It would obviously, therefore, be premature to anticipate the final de-

ductions of the authors, or to discuss the comprehensive questions which the work illustrates, from imperfect and unclassified materials. Meanwhile we may record our conviction, that for beauty of typography, and artistic skill and minute accuracy of illustration, we can scarcely conceive the work surpassed. When completed it will form a mine of information to be worked by many a succeeding laborer, and must be considered as an indispensable addition to every public and scientific library.

D. W.

SCIENTIFIC AND LITERARY NOTES.

CHEMISTRY.

FLUORINE.

Nicklès is of opinion that the usual test for fluorine is not so reliable as has been supposed. Sulphuric acid, however carefully purified, often contains traces of hydrofluoric acid, and also from the fact that the vapours of any acid, or even of water at a rather elevated temperature, are capable of acting upon glass so as to produce an engraving similar to that obtained by hydrofluoric acid, additional grounds for doubt exist. He recommends the substitution of plates of rock crystal for those of glass, that substance being acted on only by hydrofluoric acid.

ALUMINA.

Gaudin has obtained hard, brilliant and clear crystals of alumina by introducing into a crucible, luted with lamp-black, equal parts of common alum and bisulphate of potassa, previously calcined and reduced to powder. The crucible is submitted to the violent heat of a blast furnace for a quarter of an hour. On breaking the crucible we find, in the hollow of the luting, a concretion bristling with brilliant points. The alumina is separated by dilute nitromuriatic acid.

TANTALUM.

Rose has obtained a niturет of tantalum, and has described the processes for obtaining tantalic acid, perfectly pure, by fusion with the bisulphate of potassa or ammonia. The acid dissolves in the latter salt, forming a clear syrup, which remains clear for years; the solution takes place at a temperature below a dull red heat, and may be effected in a glass flask. Tantalic acid, obtained by the decomposition of the perchloride, or by the action of sulphurous acid on a solution of the tantalate of soda, differs from that obtained by fusion, inasmuch as it exhibits incandescence when heated, which the other does not. From this and other circumstances Rose concludes that there are two modifications of tantalic acid, the one convertible into the other by heat. He has also examined the various salts which it forms with potassa.

TANNIN.

By acting upon some organic compounds with boiling alkaline solutions, in an atmosphere of hydrogen, Rochleder has succeeded in decomposing several, and

producing grape sugar. Tannin, when thus treated, readily gives oxalic acid, and a yellowish amorphous substance, like gum arabic, having the same composition as cane sugar but none of its reducing power. No trace of sugar is formed during this reaction.

STRYCHNINE.

Prollius proposes a method for separating strychnine, which promises to be of considerable value in toxicological investigations. The substance is digested with alcohol and a little tartaric acid, gently evaporated to a small bulk, and filtered to separate the fat. (If evaporated to dryness the fat might be separated by ether, which does not dissolve salts of the alkaloids.) To the filtrate ammonia is added, then a small quantity of chloroform, and the whole strongly agitated. The chloroform, which settles to the bottom, is drawn off and washed, mixed with three times its bulk of alcohol, and allowed to evaporate. Fine crystals of strychnine are thus obtained in a state of absolute purity.

H. C.

MATHEMATICS AND NATURAL PHILOSOPHY.

THE RELATIONS OF GOLD TO LIGHT.

At a meeting of the Royal Institution, in June last, Professor Faraday read a communication on the relation of gold to light. In this he furnished additional views and observations of great interest, in continuation of a former paper on the same subject, read by him last year, and printed in the *Proceedings* of the Royal Institution (Vol. II. p. 310.) The general relations of *gold leaf* to light are described in the former communication. The following is a summary of the additional remarks which complete the report of Professor Faraday's observations on the subject up to this time:—Since the printing of the former paper pure gold leaf has been obtained, through the kindness of Mr. Smirke, and the former observations verified. This was the more important in regard to the effect of heat in taking away the green colour of the transmitted light, and destroying to a large extent the power of reflection. The temperature of boiling oil, if continued long enough, is sufficient for this effect; but a higher temperature (far short of fusion) produces it more rapidly. Whether it is the result of a mere breaking up by retraction of a corrugated film, or an allotropic change, is uncertain. Pressure restores the green colour, but it also has the like effect upon films obtained by other processes than beating. Corresponding results are produced with other metals. As before stated, *films* of gold may be obtained on a weak solution of the metal, by bringing an atmosphere containing vapours of phosphorous into contact with it. They are produced also when small particles of phosphorous are placed floating on such a solution; and then, as a film differing in thickness is formed, the concentric rings due to Newton's thin plates are produced. These films transmit light of various colours. When heated they become amethystine or ruby, and then when pressed become green, just as heated gold leaf. This effect of pressure is characteristic of metallic gold, whether it is in leaf, or film, or dust. Gold wire, separated into very fine particles by the electric *deflagration*, produces a deposit on glass, which, being examined, either chemically or physi-

cally, proves to be pure metallic gold. This deposit transmits various coloured rays; some parts are grey, others green, or amethystine, or even a bright ruby. In order to remove any possibility of a compound of gold, as an oxide, being present, the deflagrations were made upon topaz, mica, and rock crystal, as well as glass, and also in atmospheres of carbonic acid and of hydrogen. Still the results were the same, and ruby gold appeared in one case as much as in another. Being heated, all parts of the deposit became of an amethystine or ruby colour; and by pressure these parts could be changed so as to transmit the green ray. The production of *fluids*, consisting of very finely divided particles of gold diffused through water, was spoken of before. These fluids may be of various colours, by transmitted light, from ruby to blue; the effects being produced only by diffused particles of metallic gold. If a drop of solution of phosphorous in bisulphide of carbon be put into a bottle containing a quart or more of very weak solution of gold, and the whole be agitated, the change is brought about sooner than by the process formerly described; or if a solution of phosphorous in ether be employed, very quickly indeed; so that a few hours' standing completes the action. All the preparations have the same qualities as those before described. The differently coloured fluids may have the coloured particles partially removed by filtration; and so long as the particles are kept by the filter from aggregation, they preserve their ruby or other colour unchanged, even though salt be present. If fine isinglass be soaked in water, then warmed to melt it, and one of these rich fluids be added, with agitation, a ruby jelly fluid will be obtained, which, when sufficiently concentrated and cold, supplies a tremulous jelly; and this, when dried, yields a *hard ruby gelatine*, which being soaked in water becomes tremulous again, and by heat and more water yields a ruby fluid. The dry hard ruby jelly is perfectly analagous to the well known ruby glass, though often finer in colour, and both owe the colour to particles of metallic gold. Animal membranes may in like manner have ruby particles diffused through them, and then are perfectly analagous in their action on light to the gold ruby glass, and from the same cause. When a leaf of beaten gold is held obliquely across a ray of common light, it *polarizes* a portion of it, and the light transmitted is polarized in the same direction as that transmitted by a bundle of thin plates of glass; the effect is produced by the heated leaf as well as by the green leaf, and does not appear to be due to any condition brought on by the heating, or to internal structure. When a polarized ray is employed, and the inclined leaf held across it, the ray is affected, and a part passes the analyzer, provided the gold film is inclined in a plane forming an angle of 45° with the plane of polarization. Like effects are produced by the films of gold produced from solution and phosphorous, and also by the deposited dust of gold due to the electric discharge. The same effects are produced by the other deflagrated metals so long as the dusty films are in the metallic state. As these finer preparations could be held in place only on glass or some such substance, and as glass itself had an effect, it was necessary to find a medium in which the power of the glass was nothing; and this was obtained in the bisulphide of carbon. Here the effect of gold upon a ray of light which was unaffected by the glass supporting it, was rendered manifest, not only to a single observer, but also to a large audience. The object of these investigations was to ascertain the varied powers of a substance acting upon light, when its particles were extremely divided, to the exclusion of every other change of constitution. It was hoped that some of the very important differences in the action upon the rays might in

this way be referred to the relation in size or in number of the vibrations of the light and the particles of the body, and also to the distance of the latter from each other, and as many of the effects are novel in this point of view, it may be anticipated that they will prove of service to the physical philosopher.

THE SUPPOSED DECENNIAL INEQUALITY IN THE LUNAR-DIURNAL MAGNETIC VARIATION.

In 1854 General Sabine stated to the British Association that he had at that time found no trace, in the magnetic variations depending on the moon, of the ten-years period which is so distinctly marked in those depending on the sun, and in 1856, after an elaborate discussion of the Toronto observations, he stated this conclusion to be decisively confirmed. M. Kreil having, however, indicated an opinion that the observations at Milan and Prague rather favored the supposition that the same decennial period which exists in the solar variation affects also the lunar magnetic influence, General Sabine, with the unwearying zeal which distinguishes him, has submitted to analysis the eight years observations at Hobarton, and finds therein confirmation of the conclusions he had arrived at from the Toronto observations, namely, that no such decennial period as Mr. Kreil supposed is to be traced in the magnetic influence of the moon, while such a period is indubitably shewn in that of the sun, whether examined by means of the "disturbances," or of the "mean" solar variation. With regard to the former General Sabine remarks that, "when the disturbances, occurring at Hobarton during eight years, are broken into four distinct and equal portions, each of two years duration, each such portion manifests the same periodical law of diurnal variation, almost identical in the principal features of direction and turning hours, and differing only in the magnitude of the variation in different years, in which difference it conforms strictly to the decennial period, as indicated elsewhere, having a minimum in 1843-44, and a maximum five years later. This law may be accounted a general one, since it has been found to prevail at stations so widely distant from each other as Toronto, St. Helena, and Hobarton." The same result follows when the mean diurnal solar variation, the larger disturbances being excluded, is examined, both for the eight years 1841-8, when the observations were made hourly, and also when the six succeeding years are included, during which two-hourly observations were taken. By treating in the same way the lunar-diurnal variations, General Sabine shows that the differences in these "show no conformity to the inequality manifested in those of the solar-diurnal variations." With this weight of evidence, we may fairly conclude that the ten years' period has no existence for the moon, and thank General Sabine for the settlement of this vexed question.

ON THE COMPOSITION OF COLOURS.

Professor Challis, in the Phil. Mag., November, 1856, has attempted to give an explanation of this difficult matter, on the principles of the undulatory theory. Taking for his guide the analogy of sound, and a hint thrown out by Sir J. Herschel in his well-known treatise, Professor Challis proceeds to compound two simple undulations of different wave-lengths. As a musical note is produced by a regular succession of similar vibrations, while a mere noise is produced by irregular impulses, so he conceives a simple colour to consist of vibrations, whose type composes only one wave length and amplitude, while a mixed colour, of whiteness, is produced by the coëxistence of different types; melody thus corresponding to pure colour, harmony to mixed colour, and unmusical noise to white

light. By throwing the compounded velocity of two colours (taking the usual cycloidal type) into a peculiar analytical form, he shows that the resulting vibration will consist partly of a colour whose wave-length is a harmonic mean between those of the original, and partly of irregularities, which may cause the sensation of whiteness, and dilute the colour, and may sometimes be powerful enough to overcome the sensation of colour altogether. This, however, requires that the maximum velocities in each vibration shall not be very different from each other, and Professor Challis ingeniously employs this to account for the fact that the mixing of coloured substances produces different results from the mixing of the prismatic colours which to all appearance are identical with the former. The method gives a good explanation of complementary colours, and of several other well-known facts in colour-compounds, as given by Newton, Helmholtz, Maxwell, and others. It also leads to the abandonment of the doctrine (always looked on with suspicion) of three primitive colours. There is one point Professor Challis does not notice, which is this: in the composition of two musical notes, whether, by the superposition of vibrations on the vibrating body (as in a string, giving out two notes at the same time), or by their union on entering the ear, each note is still heard separately, and the sensation of harmony is altogether different from the perception of its components; in colour, however, the union of the two may destroy this perception of the components, and give rise to a single sensation only. Now, if we take the same precise analytical forms of vibration in the two cases, it does not appear manifest how this distinction may be made visible in the analytical result. The whole subject is, however, a very difficult one, and, whether altogether sound or not, this idea of Professor Challis is well worth carrying out.

PROFESSOR W. THOMSON'S BAKERIAN LECTURE (R. S., FEB. 28, 1856.)

This lecture communicates some most valuable discoveries and experiments made by the author in electro-thermotics. (1.) An electric current in an unequally heated conductor, if its nominal direction be from hot to cold through the metal, causes a cooling effect in iron and a heating effect in copper. Brass has the same property as copper, and platinum as iron, with respect to this electric conversion of heat. (2.) In thermo-electric inversion between metals, a mode of experimenting is described by which inversions, when they exist, may readily be detected, and the temperature of neutrality determined with precision. Various substances have in this way been subjected to trial by the author. (3.) The effects of mechanical strain, and of magnetisation, on the thermo-electric qualities of metal, are investigated. In a mass of iron under longitudinal stress, the thermo-electric quality *across* lines of traction differs from that *along* lines of traction as bars of bismuth differ from bars of antimony. Unstrained iron has intermediate thermo-electric quality between those of the two critical directions under distorting stress. The effect of permanent lateral compression is the same as that of permanent longitudinal extension, or of hardening by wire-drawing, upon the thermo-electric quality of a wire placed lengthwise in an electric circuit in iron, being a deviation from the [*un?*] constrained metal towards bismuth, and in the other metals (copper, tin, brass, platinum, cadmium and lead [?]), a deviation towards antimony; also that in copper and iron, it is the reverse of the effect experienced by the same metal while under the stress that caused the strain. Generally, it is inferred, that in iron hardened by compression in one direction,

the thermo-electric qualities in this direction differ from those in lines perpendicular to it as antimony differs from bismuth; that the reverse statement applies to iron hardened by traction in one direction; and that in each case the thermo-electric quality of soft iron is intermediate to the two differing states.

Again, in soft iron under magnetic force, and in that permanently magnetised after the removal of the magnetising force, directions along the lines of magnetisation deviate thermo-electrically towards antimony, while those perpendicularly across the lines of magnetisation deviate towards bismuth, from the unmagnetised metal. Thus if a riband of iron, magnetised at an angle of 45° to its length, be heated along one edge while the other is kept cool, when the two ends, kept at the same temperature are put in communication with the electrodes of a galvanometer, a powerful current is indicated, in such a direction that, if pursued along a rectangular zigzag from edge to edge through the band, the course is always from *across* to *along* the lines of magnetisation through the *hot* edge, and from *along* to *across* the same lines through the *cold* edge. (4.) Various experiments were made to detect the effects of certain influences on the electric conductivities of metals. For instance, longitudinal magnetisation diminishes the conducting quality of iron wire, and its electric conductivity is greater across than along lines of magnetisation; also, by magnetisation across the lines of electric current, iron gains in conducting power, whence it is inferred that there is a certain direction, oblique to the lines of magnetisation, along which the conductivity of magnetised iron would remain the same on a cessation of the magnetising force.

ON THE TEMPERATURE AT TORONTO.

In the Phil. Mag., Nov., 1856, Mr. S. M. Drach points out that General Sabine's formula (Phil. Trans., 1852) can be put approximately into the simple form—

$$44^\circ.23—21^\circ.81 \sin a—1^\circ.06 \cos 2a—0^\circ.80 \cos 3a+0^\circ.22 \cos 4a—0^\circ.88 \sin 5a$$

where a is the angle reckoned at 30° a month from October 24th, which is the epoch of mean annual temperature. Hence he suggests that the meteorological year should be taken from October to September inclusive.

A NEW SPHYGMOSCOPE.—BY DR. S. SCOTT ALISON, (PROC. L.S.)

This instrument, designed for the purpose of indicating the movements of the heart and blood-vessels, consists of 'a small chamber containing spirits of wine or other liquid, provided with a thin india-rubber wall where it is to be applied to the chest. This chamber communicates with a bent graduated tube which rises to some height above the level of the chamber; liquid is supplied to the instrument till it spreads in the tube a little above the level of the chamber. The pressure of this liquid, acting on the elastic wall, causes it to protrude, and the protruding part is very sensible to external impulse, yielding to the slightest touch, and, being pushed inwards or returning outwards, causes a rise or fall of the liquid in the tube, the amount and duration of which can be estimated with much delicacy. By means of this instrument, Dr. Alison has detected two great laws not hitherto known, namely, 'that the beat of the heart *alternates* with the pulse of the wrist,' and, 'that the pulse of arteries beyond the chest takes place in all parts at the same instant, and without any appreciable interval.'"

PHOTOGRAPHY.

The attention of Photographers has been mainly directed of late to the perfecting of some dry process by which the necessity of immediately using the wet

collodion film may be obviated. Many modifications of Shadbolt's original honey-process have been proposed, and the use of various substances, such as glycerine metagelatine, golden-syrup, oxymel, has been recommended, all adopting for their basis the principle of washing off the free nitrate of silver after the plate has been excited, and then covering it with the preservative syrup which keeps it moist and prevents the small excess of free nitrate left on the collodio-iodide from drying and crystallising. Another plan, claimed by several originators, is remarkable, consisting in leaving the excited plates in distilled water, when, if protected from the light, they will retain their sensitiveness for weeks unimpaired. The most promising however seems to be Taupenot's Albumen process (described in Can. Journ., Vol. I., N.S., pp. 195) of which the following is the latest simplification, as practised by Mr. H. P. Robinson. The Nitrate-Bath consists of: Nitrate of Silver, 35 grs., Glacial Acetic Acid, 1 min., Distilled Water, 1 oz. Having coated the plate with collodion, and excited as usual, let it be immersed for about one minute in distilled water, then washed for two or three minutes under a tap, allowed to drip for a minute, and then have poured over it some iodised albumen which need only remain for a few seconds on it. This iodised albumen is made as follows: Albumen, 1 oz.; Distilled Water, 2 drachms; Ammonia, 8 minims; Iodide of Ammonia, 5 grs.; Bromide of Ammonia, 1 gr.; dissolve the iodide and bromide in the water, and then add the ammonia to the albumen, beat the whole into a froth, and, when again liquified, strain through calico. The plates may now be put away to dry; they are perfectly insensitive to light, and will keep for any length of time. When wanted for use, dip them again into the nitrate-bath for one minute, and wash precisely as before. They are now ready for the camera, and may be kept (in darkness of course) for weeks without losing sensitiveness. Develope with pyro-gallic acid, adding free nitrate, if necessary, (this is a long process), and fix with hyposulphite of soda.

Mr. Hardwich has brought out another edition of his excellent treatise on Photographic chemistry: he now recommends the use of fused nitrate of silver instead of the crystallised. Mr. Scott Archer, the inventor of the Collodion process has died, leaving a widow and family in distressed circumstances. A committee of the Photographic Society has been formed to raise a subscription for them and to urge their claims on government for pecuniary aid. Mr. Crookes and Mr. Grubb have succeeded in procuring photographic images of the moon—the former with the Liverpool Equatorial obtaining good negatives in four seconds. No practical benefit seems likely to result from this mode of operation, as the minute image thus formed loses its distinctness on being magnified. Is Bromine of any use in Photography? It seems conceded that in the paper-processes Bromine is useful in gaining intensity; but in collodion there does not appear to be the same result. For some time it was imagined that the Bromide was peculiarly sensitive to the green rays of the spectrum, and was on this account advantageously employed when vegetation and foliage were to be photographed; but Mr. Crookes has shown that the only part of the spectrum where it enjoys any advantage over the Iodide is the unimportant and narrow strip between Fraunhöfer's *b* and *G*, so that its fancied superiority vanishes compared with the injury it inflicts on the film. Mr. Shadbolt has confirmed by a remarkable experiment the inference of M. Claudet, that the yellow rays not only destroy the actinic effect of the blue, but actually reverse it. Mr. Shadbolt says: "I coated and excited a glass plate in the usual way, and exposed it to the light. I then took a piece of stained

yellow glass and covered with it one half of this plate. I then exposed the whole to the direct rays of the sun for ten minutes, and afterwards placed the same plate in the camera in order to attempt to take a picture upon it. In developing, the part I had covered with yellow glass after previously exposing the whole to the light, produced a picture, (though not a very good one), and the part left uncovered, produced, as might have been expected, a perfect mass of blackness; hence I conclude that the yellow glass undid the work that had previously been done by the ordinary light."

Photographers seem now to be pretty generally convinced that positive paper prints, if toned by hyposulphite of soda, will fade when exposed to moisture. Mr. Shadbolt publishes a process in which sulphide of silver (a permanent compound) is substituted for the ordinary sulphuret. The paper is salted on a bath of gelatine, 1 gr.; Chloride of Ammonium, 10 grs; Water, 1 oz. After exposure, it is washed with water, then with liq. amm. fort. diluted with four or five times its bulk of water; again washed with plain water, and then toned with a solution of hydrosulphite of ammonia; a final washing and drying completes the picture. The tone is said to be an agreeable brownish black, which acquires a yellowish tinge by time.

THE GREENWICH OBSERVATORY.

In the report of the Astronomer Royal to the Board of Visitors, the following curious fact is mentioned: "There is a well-marked annual periodical change in the position of the Transit Circle, the southerly movement of the eastern pivot having its minimum value in September, and its maximum in March, the extreme range being about 14 seconds; and there is a similar change, but of smaller amount, in the position of the Collimator. I cannot conjecture any cause for these changes, except in the motion of the ground. There is a very frequent change of still smaller amount in the Azimuth of the Transit Circle, accompanied by a nearly equal change in the apparent Azimuth of the Collimator, so that from day to day the Transit Circle and Collimator preserve their relative position unaltered; these I conceive to be the effects of accident in observation of the circumpolar stars, arising either from fault of the observer, or from irregularities either in the level or in the collimation; at the same time, viewing the great accuracy of the observations of circumpolar stars, and the extreme simplicity of the pivot-supports and of the instrument frame, I cannot conjecture how such irregularities can arise." During the past winter, Mr. Airy received intimation from Prof. Hansteen that the dip, as determined at Greenwich, appeared to have become greater than was consistent with the changes of dip going on in the North of Europe. A similar discordance was found to exist between Greenwich and Kew. This led Mr. Airy to examine the observatory instrument, and it was found so imperfect in its mechanical construction, that when the needle was lifted up from its agate bearings, its upper point almost always struck the brass circle. These defects have been amended, and the apparent dip is diminished by nearly the quantity which Prof. Hansteen conjectured. Mr. Airy regrets that this irregularity unfortunately causes the dip-observations at Greenwich for several years past to possess very little value.

COLONIAL MAGNETIC OBSERVATORIES.—BY MAJOR GEN. SABINE. (PROC. R. S.)

The magnetic investigations designed to be carried into execution by the Colonial Observatories recommended by the Royal Society, embraced a much wider

scope than had been contemplated by any previous institutions, or than had been provided for by the arrangements or instrumental means of any then existing establishment, whether national or private. Not, as previously, limited to observations of a single element (the declination)—or combining at the most one only of the components of the magnetic force,—the instructions of the Royal Society, and the instrumental means prepared under its direction, provided for the examination, in every branch of detail, of each of the three elements which, taken in combination, represent, not partially, but completely, the whole of the magnetic affections experienced at the surface of the globe, classed under the several heads of absolute values, secular changes, and variations either periodical or occasional, —and proceeding from causes either internal or external. To meet the requirements of inductive reasoning, it was needful the results to be obtained should comprehend all particulars under these several heads, attainable by an experimental inquiry of limited duration. That no uncertainty might exist as to the objects to which, in so novel an undertaking, attention was to be directed, the Report of the Committee of Physics, approved and adopted by the President and Council of the Royal Society, stated in a very few sentences, remarkable alike for their comprehensiveness and conciseness, the desiderata of magnetical science. It may be convenient to reproduce these, when desiring to show the degree in which the Observatories have fulfilled their contemplated purposes.—"The observations will naturally refer themselves to two chief branches, into which the science of terrestrial magnetism in its present state may be divided. The first comprehends the actual distribution of the magnetic influence over the globe, at the present epoch, in its mean or average state, when the effects of temporary fluctuations are either neglected or eliminated by extending the observations over sufficient time to neutralise their effects. The other comprises the history of all that is not permanent in the phenomena, whether it appear in the form of momentary, daily, monthly, or annual change and restoration; or in progressive changes not compensated by counter-changes, but going on continually accumulating in one direction, so as in the course of many years to alter the mean amount of the quantities observed."

With reference to the first of these two branches, viz., the actual distribution of the magnetic influence over the globe at the present epoch, the Report goes on to state:—"The three elements, viz., the horizontal direction, the dip, and the intensity of the magnetic force, require to be precisely ascertained, before the magnetic state of any given station on the globe can be said to be fully determined ......and as all these elements are at each point now ascertained to be in a constant state of fluctuation, and affected by transient and irregular changes, the investigation of the laws, extent, and mutual relations of these changes is now become essential to the successful prosecution of magnetic discovery."

With reference to the second branch, viz., the secular and periodical variations, it is observed that—"The *progressive* and *periodical* being mixed up with the *transitory* changes, it is impossible to separate them so as to obtain a correct knowledge and analysis of the former, without taking express account of and eliminating the latter;" and with reference to the secular changes in particular, it is remarked—"These cannot be concluded from comparatively short series of observations without giving to those observations extreme nicety, so as to determine with perfect precision the mean state of the elements at the two extremes of the

period embraced; which, as already observed, presupposes a knowledge of the *casual* deviations."

It is clear from these extracts that in the discussion of the observations, the first point, in the order of time, ought necessarily to be an investigation into "the laws, extent, and mutual relations of the *transient* and," (as they were called at the time the Report was written,) "*irregular* changes," as a preliminary step to the elimination of their influence on the observations, from which a correct knowledge and analysis of the progressive and periodical changes were to be obtained. It will be proper to show therefore, in the first place, what the Observatories have accomplished in regard to the so-called casual or transitory variations.

Casual Variations.—All that was known regarding these phenomena at the period when the Report of the Committee of Physics was written, was, that there occurred occasionally, and, as it was supposed, irregularly, disturbances in the horizontal direction of the needle, which were known to prevail, with an accord which it was impossible to ascribe to accident, *simultaneously* over considerable spaces of the earth's surface, and were believed to be in some unknown manner connected, either as cause or effect, with the appearances of the aurora borealis. The chief feature by which the presence of a disturbance of this class could be recognised at any instant of observation,—or by which its existence might be subsequently inferred independently of concert or comparison with other Observatories,—appeared to be, the deflection of the needle from its usual or normal position to an amount much exceeding what might reasonably be attributed to irregularities in the ordinary periodical fluctuations. The observations which had been made on the disturbances anterior to the institution of the Colonial Observatories had been chiefly confined to the declination. A few of the German Observatories had recently begun to note the disturbances of the horizontal force; but as yet no conclusions whatsoever had been obtained as to their laws: in the words of the Committee's Report, the disturbances "apparently observe no law." By the instructions cited above, the field of research was enlarged, being made to comprehend the disturbance-phenomena of the *three* elements; and the importance of their examination was urged, not alone as a means of eliminating their influence on the periodic and progressive changes, but also on the independent ground, that "the theory of the transitory changes might prove itself one of the most interesting and important points to which the attention of magnetic inquirers can be turned, as they are no doubt intimately connected with the general causes of terrestrial magnetism, and will probably lead us to a much more perfect knowledge of those causes than we now possess."

The feature which has been referred to as furnishing the principal if not the only certain characteristic of a disturbance of this class, viz., the *magnitude* of the departure from the usual or normal state at the instant of observation, has, in the discussion of the observations, been made available for the investigation of their laws: it has afforded the means of recognizing and separating from the entire mass of hourly observations, taken during several years, a sufficient body of observations to furnish the necessary data for investigating at three points of the earth's surface—one in the temperate zone of the northern hemisphere, a second in the temperate zone of the southern hemisphere, and a third in the tropics—the laws or conditions regulating or determining the occurrence of the magnetic disturbances. The method by which this separation has been effected has been explained on several recent occasions, and will be found fully described in the Phil-

Trans. for 1856, Art. XV. By a process of this description, the disturbances of principal magnitude in each of the three elements, the Declination, Inclination and Total Force, have been separated from the other observations, at the three Observatories of Toronto, Hobarton, and St. Helena, and submitted to an analysis of which the full particulars will be found in the preliminary portions of the volumes which record the observations. By the adoption of a uniform magnitude as constituting a disturbance throughout the whole period comprised by the analysis, the amount of disturbance in the several years, months, and hours, is rendered intercomparable. The result of this investigation (which could not be otherwise than a very laborious operation, since the observations at a single one of these stations, Toronto, considerably exceeded 100,000 in number, each of which had to be passed through several distinct processes,) has made known to us that the phenomena of this class, which may in future with propriety and advantage receive the appellation of "*occasional;*" are, in their mean or average effects, subject to periodical laws of a very systematic character; placing them, as a first step towards an acquaintance with their physical causes, in immediate connexion with the sun as their primary exciting cause. They have—1, a *diurnal* variation which follows the order of the solar hours, and manifests therefore its relation to the sun's position as affected by the earth's rotation on its axis; 2, an *annual* variation, connecting itself with the sun's position in regard to the ecliptic; and 3, a third variation, which seems to refer still more distinctly to the *direct* action of the sun, since, both in period and in epochs of maximum and minimum, it coincides with the remarkable solar period of about ten, or perhaps more nearly eleven, of our years, the existence of which period has been recently made known to us by the phenomena of the solar spots; but which, as far as we yet know, is wholly unconnected with any thermic or physical variation of any description (except magnetic) at the surface of the earth, and equally so with any other cosmical phenomena with which we are acquainted. The discovery of a connexion of this remarkable description, giving apparently to magnetism a much higher position in the scale of distinct natural forces than was previously assigned to it, may justly be claimed on the part of the Colonial Observatories, as the result of the system of observation enjoined (and so patiently and carefully maintained), and of the investigation for which it has supplied the data; since it was by means of the disturbance-variations so determined, that the coincidence between the phenomena of the solar spots and the magnitude and frequency of magnetic disturbances was first perceived and announced (Phil. Trans. 1852, Art. VIII.)

The extent and mutual relation of the disturbance-variations of the three elements, even at a single station, supply a variety of points of approximation and of difference, which are well suited to elucidate the physical causes of these remarkable phenomena; but valuable as such aids may be when obtained for a single station, their value is greatly augmented when we are enabled to compare and combine the analogous phenomena, as they present themselves at different points of the earth's surface. To give but a single example:—there are certain variations produced by the mean effects of the disturbances which attain their maximum at Toronto during the hours of the night; the corresponding variations attain their maximum, at Hobarton, also during the hours of the night, but with a small systematic difference as to the precise hour, and with this distinguishing peculiarity, that the deflection at Hobarton is of the opposite pole of the needle (or of the same pole in the opposite direction,) to the Toronto disturbance; whilst

at a third station, St. Helena, which is a tropical one, the hours of principal disturbance are those not of the night, but of the day. A very superficial examination is sufficient to show that for the generalization of the facts,—a generalization which is indispensable for their correct apprehension and employment in the formation of a theory,—the stations at which the phenomena are to be known must be increased. Those which were chosen for a first experiment were well selected to prove the importance of the investigation, and thus to lead to its extension. It is only at the Colonial Observatories that the disturbance-variations have hitherto been made out; and taking experience as our guide, we have before us the evidence of the means by which the inquiry may be further successfully prosecuted.

Periodical Variations.—The anticipation expressed in the Report of the Committee of Physics, that for the purpose of obtaining a correct knowledge of the *regular periodical variations*, it would be found necessary to eliminate the "casual perturbations," has been fully confirmed. Had the latter been strictly "casual" (or accidental, in a sense contradistinguished from and opposed to periodical), a sufficiently extended continuance of observation might have occasioned their mutual compensation; but now that we have learned that the mean effects which they produce are governed by periodical laws, and that these laws and those of the regular periodical variations are dissimilar in their epochs, it is manifest that in their joint and undivided effects we have two variations, due to different causes and having distinct laws, superimposed upon each other; *to know the one correctly we must necessarily therefore eliminate the other.* A striking illustration of the importance of such elimination is furnished by the solar-diurnal variation of the total force. It will readily be imagined that the question must be an important one, whether a variation, which is supposed to derive its origin from the sun, be a single or a double progression; whether it have two maxima and two minima in the twenty-four hours, or but one maximum and one minimum in that period. When no separation is made of the disturbances, the progression appears to be a double one, having two minima, one occurring in the day and the other in the night. With the removal of the disturbed observations the night minimum disappears, and we learn that the regular solar-diurnal variation of the total force has but one notable inflection in the twenty-four hours, viz., that which takes place during the hours when the sun is above the horizon. The night minimum is in fact the mean effect of the occasional disturbances. It is probable that the nocturnal inflection of the solar-diurnal variation of the Declination may be ascribed to the same cause, namely to the superposition of two distinct variations.

A careful analysis of the solar-diurnal variations of the Declination at the Colonial Observatories has brought to light the existence at all these stations, of an *annual inequality* in the direction of the needle concurrent with changes in the sun's declination, having its maxima (in opposite directions) when the sun is in or near the opposite solstices, and disappearing at or near the epochs of the equinoxes. An intercomparison of the results of the analysis at these stations has shown, that this inequality has the remarkable characteristic of having notably the same direction and amount in the southern as in the northern hemisphere, and in the tropical as in the temperate zones. An ingenious explanation of the phenomena has been suggested by Dr. Langberg of Christiana (Proceedings of the Royal Society, vol. vii., p. 434); but whether this explanation be or be not the correct one, the theoretical importance of the facts cannot be doubted, inasmuch as they appear to be wholly irreconcileable with the hypothesis which would attribute the

magnetic variations to thermic causation. We may ascribe to the general and almost exclusive prevalence of the thermic hypothesis, and to its influence on magnetic reasonings, that the well-known erroneous opinion was so confidently promulgated by a deservedly high magnetic authority, that a line *must* exist surrounding the globe, in which the needle would be found to have *no diurnal variation.* We have now, on the contrary, reason to be assured, by the facts of the annual inequality thus discovered, that there is no such line; but that everywhere in the regions of its supposed existence a diurnal variation subsists, having opposite characteristics in opposite parts of the year as influenced by the sun's position on either side of the equator, and disappearing only at the epochs when the sun passes from south to north or from north to south Declination.

Lunar Variation.—But if thermic relations have failed to supply a connecting link between the sun and those magnetic variations which are, without doubt, referable to the *sun* as their primary cause, the failure of that hypothesis is made still more obvious by the existence of variations governed by the *moon's* position relatively to the place of observation. We are indebted to M. Kreil, now holding the same position in Austria that I have filled in England, for the first suggestion of the existence of a lunar-diurnal variation of one of the elements, viz., of the Declination, founded on observations at Milan and Prague; and in the Phil. Trans. for 1856, Art. XXII., will be found an exposition of the facts of the moon's diurnal influence on each of the three magnetic elements at Toronto, viz., on the Declination, Inclination and Total Force. In the case of this investigation, notwithstanding the smallness of the values concerned, the instrumental means supplied to the Colonial Observatories have been found competent to determine, with an approximation sufficient for present theoretical purposes, the character and amount *for each element* of the regular daily effect of the moon on the terrestrial magnetic phenomena, the existence of which does not appear to have been even suspected at the time when the Report of the Committee of Physics was drawn up. The *discovery* of the moon's influence on any of the magnetic elements is due, as already stated, to M. Kreil; but Toronto is the first, and as yet the only, station, at which the numerical values at every lunar hour of the lunar-diurnal variations of the three elements have been published. Corresponding statements to that which has been given for Toronto, will be found for St. Helena and Hobarton, in the volumes of those observatories, which are now in preparation. All the results at the three stations present the same *general* characters. The lunar influence does not appear to participate in the decennial inequality which is found in all the solar variations (Phil. Trans. 1857, Art. I.). The lunar-diurnal variation of each of the elements is a double progression in the twenty-four hours, having epochs of maximum and minimum symmetrically disposed. In *character*, therefore, it differs from what might be expected to take place if the moon were possessed of inherent magnetism, *i. e.* if she were a magnet, as it is usually termed, *per se;* and accords with the phenomena which might be expected to follow if she were magnetic only by induction from the earth. On the other hand, it is believed that the *amount* of the variation, as observed at each of these stations, very far exceeds what can be imagined to proceed from the earth's inductive action reflected from the moon. In this theoretical difficulty we are naturally thrown back to seek a more extensive knowledge of the phenomena than we have yet obtained, and to the generalization which will follow, when sufficient materials for it have been procured. In subordinate particulars, a difference, which is apparently systematic

is perceived to exist in regard to the hours which constitute the epochs of maxima and minima at the three stations, as well as in regard to the amounts of the respective variations; these differences are no doubt intimately connected with the causes of the phenomena, and are likely to lead to their elucidation.

The domain of periodical variations has thus been considerably enlarged since the Report of the Committee of Physics was drawn up; and must henceforth be understood to comprise, in addition to the variations "whose amount is a function of the hour-angle of the sun, and of his longitude" (or of his declination) (Report, p. 10),—1stly, those variations of the three elements whose amount is a function of the hour-angle of the moon; 2ndly, those variations which were classed in the Committee's Report as "irregular," or "apparently observing no law," but which are now known to be governed by laws depending on the sun's declination, and hour-angle; and 3rdly, those variations, both "irregular" and "occasional," which have their epochs and amounts dependent apparently on a solar period of not yet perfectly ascertained duration, manifesting itself also by periodical changes in the frequency and amount of the solar spots.

Absolute Values and Secular Changes.—But interesting and valuable as is the acquisition of a fuller and more precise knowledge of the comparatively small magnetic variations produced at the surface of the earth by the action or influence of external bodies, even greater importance seems to attach,—when *terrestrial* magnetism is in question,—to the purposes of that distinct branch of the duties of a magnetic observatory, which consists in the determination of the absolute values and secular changes of the three magnetic elements. By the *absolute values* we seek to acquire a knowledge of the actual present order and distribution of the terrestrial magnetic influence at the surface of the earth, and to provide the materials by which the constancy, or otherwise, of the earth's magnetic charge may hereafter be examined; and by determinations of the present direction and amount of the *secular changes*, we seek to become acquainted with the laws, and ultimately with the causes, of that most mysterious change, by which the magnetic condition of the globe at one epoch passes progressively and systematically into that of another. It is specially by determinations of this class, obtained with the necessary precision in different parts of the globe, that, in the words of the Committee's Report, "the patient inductive inquirer must seek to ascend to the general laws of the earth's magnetism." At the time when the Report of the Committee of Physics was written, doubts were reasonably entertained, whether the limited time, during which the Colonial Observatories were likely to be maintained in action, would be sufficient for the determination of the secular changes; and it was therefore very properly argued, that these changes cannot be concluded from comparatively short series of observations without giving to the observations *extreme nicety*, so as to determine with perfect precision the mean state of the elements at the two extremes of the period embraced. It is with much satisfaction, and with a well-deserved recognition of the pains which have been bestowed by the successive directors of the Toronto Observatory, and their assistants, on this branch of their duties, that I am able to refer to the determinations of the absolute values and secular changes of the three elements contained in the third volume of the Toronto observations, in evidence that the instrumental means which were devised, and the methods which have been adopted, have proved, under all the disadvantages of a first essay, sufficient to determine these data with a precision which is greatly in advance of preceding experience, and, as far as may be

judged, equal to the present requirements of theoretical investigation. This is the more deserving of notice, because Toronto is a station where the casual and periodical variations, which it was apprehended would seriously interfere with the determination of absolute values, are unusually large. We may derive, therefore from the results thus obtained, the greatest encouragement to persevere in a line of research which is no longer one of doubtful experiment, and to give it that further extension which the interests of science require.

Amongst the results which have recompensed the labours of the Colonial Observatories in this branch of their inquiries, perhaps there is none of more importance in respect to the general theory of terrestrial magnetism, than the conclusion which has been established by means of the observations of the Declination at St. Helena, that the current annual amount of secular change takes place by *equal aliquot portions in every month, and even in every fortnight of the year.* The magnitude of the annual change of the Declination at St. Helena, 8′ (or more precisely 7′·93 in each of the eight years in which the observations were maintained), and the comparative tranquillity of the tropical regions in regard to magnetic disturbances, were circumstances which rendered St. Helena a particularly eligible locality for an investigation of this nature. The result has been, to remove secular change altogether from the category of atmospheric or thermic relations, with which, in the absence of a correct knowledge of the facts, it has frequently been erroneously associated; and to show conclusively that it is a phenomenon of far more systematic order and regularity than has been generally apprehended (Proceedings of the Royal Society, vol. vii. pp. 67–75).

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

One of the most brilliant and successful meetings which have signalized the progress of the British Association in the accomplishment of its important aims, opened at Dublin on the 26th of August. Twenty-two years have elapsed since last the Association graced the halls of the Irish Capital: and great as are the changes every where noticeable in such a lapse of time, a more momentous epoch has not occurred in the history of Ireland. To whatever city the Association returns after such an interval, the survivors who bore a part in its deliberations and discussions, must recall many former valued coadjutors now no more; while also the hopeful and cheering element is not wanting. The eager boy who then gratified his vague longings by a stolen peep into the sections, is now seen entering as a scientific cadet, and doing duty on the local committee, or honored with a special and recognized rank as a secretary of his favourite section; while again the youthful sectional secretary of former years, now steps down into the arena, acknowledged as an equal among the veterans of science.

After the usual preliminary business, including the reading of the Report of the Council to the General Committee, and the presentation of the reports of the Kew Observatory, the Parliamentary Committee, and the General Treasurer; the members and friends of the association assembled in the Rotunda, where Professor Daubeny resigned the chair to his successor, the Rev. HUMPHREY LLOYD, D. D.

After some interesting reminiscences of a personal and local nature, with which the President opened his Address, he thus proceeded in accordance with the well

approved practice of presidents of the British Association, to give an epitome of some of the most remarkable recent additions to science:

"To commence, then, with *Astronomy*:—The career of planetary discovery, which began in the first years of the present century, and was resumed in 1845, has since continued with unabated ardour. But since 1846 not a single year has passed without some one or more additions to the number of the planetoids; and in one year alone (1852), no fewer than *eight* such bodies were discovered. The last year has furnished its quota of *five*, and in the present *three* more have been found, one by Mr. Pogson, of Oxford, and the other two by M. Goldschmidt, of Paris. The known number of these bodies is now forty-five. Their total mass, however, is very small. The diameter of the largest is less than forty miles, while that of the smallest (Atalanta) is little more than four. These discoveries have been facilitated by star-maps and star-catalogues, the formation of which they have on the other hand stimulated. Two very extensive works of this kind are now in progress—the Star-Catalogue of M. Chacornac, made at the Observatory of Marseilles, in course of publication by the French Government; and that of Mr. Cooper, made at his observatory at Markree, in Ireland, which is now being published by the help of the Parliamentary Grant of the Royal Society. It is a remarkable result of the latter labour, that no fewer than seventy-seven stars, previously catalogued are now missing. This, no doubt, is to be ascribed in part to the errors of former observations; but it seems reasonable to suppose that, to some extent at least, it is the result of changes actually in progress in the Sidereal System. The sudden appearance of a new fixed star in the heavens, its subsequent change of lustre, and its final disappearance, are phenomena which have at all times attracted the attention of astronomers. About twenty such have been observed. Arago has given the history of the most remarkable, and discussed the various hypotheses which have been offered for their explanation. Of these, the most plausible is that which attributes the phenomenon to unequal brightness of the faces of the star which are presented successively to the earth by the star's rotation round its axis. On this hypothesis the appearance should be *periodic*. M. Goldschmidt has recently given support to this explanation, by rendering it probable that the new star of 1609 is the same whose appearance was recorded in the years 393, 798, and 1203. Its period, in such case, is 405½ years. The greater part of the celestial phenomena are comprised in the movements of the heavenly bodies and the configurations depending on them; and they are for the most part reducible to the same law of gravity which governs the planetary motions.

"But there are appearances which indicate the operation of other forces, and which, therefore, demand the attention of the physicist—although, from their nature, they must probably long remain subjects of speculation. Of these, the spiriform nebulæ, discovered by Lord Rosse, have been already referred to from this chair, as indicating changes in the more distant regions of the universe, to which there is nothing entirely analogous in our own system. These appearances are accounted for, by an able anonymous writer, by the action of gravitating forces combined with the effects of a resisting medium—the resistance being supposed to bear a sensible proportion to the gravitating action.

"The constitution of the central body of our own system presents a nearer and more interesting subject of speculation. Towards the close of the last century many hypotheses were advanced regarding the nature and constitution of the sun,

all of which agreed in considering it to be an opaque body, surrounded at some distance by a luminous envelope. But the only certain fact which has been added to science in this department is the proof given by Arago that the light of the sun emanated (not from an incandescent solid, but) from a gaseous atmosphere, the light of incandescent solid bodies being *polarized by refraction*, while the light of the sun, and that emitted by gaseous bodies, is *unpolarized*. According to the observations of Schwabe, which have been continued without intermission for more than thirty years, the magnitude of the solar surface obscured by spots increases and decreases *periodically*, the length of the period being 11 years and 40 days. This remarkable fact, and the relation which it appears to bear to certain phenomena of terrestrial magnetism, have attracted fresh interest to the study of the solar surface; and, upon the suggestion of Sir John Herschel, a photoheliographic apparatus has lately been established at Kew, for the purpose of depicting the actual macular state of the sun's surface from time to time. It is well known that Sir William Herschel accounted for the solar spots by currents of an elastic fluid ascending from the body of the sun, and penetrating the exterior luminous envelope. A somewhat different speculation of the same kind has been recently advanced by Mosotti, who has endeavoured to connect the phenomena of the solar spots with those of the *red protuberances* which appear to issue from the body of the sun in a total eclipse, and which so much interested astronomers in the remarkable eclipse of 1842.

"Next to the sun, our own satellite has always claimed the attention of astronomers, while the comparative smallness of its distance inspired the hope that some knowledge of its physical structure could be attained with the large instrumental means now available. Accordingly, at the meeting of the Association held at Belfast in 1852, it was proposed that the Earl of Rosse, Dr. Robinson, and Prof. Phillips, be requested to draw up a Report on the physical character of the moon's surface, as compared with that of the earth. That the attention of those eminent observers has been directed to the subject, may be inferred from the communication lately made by Prof. Phillips to the Royal Society on the mountain Gassendi, and the surrounding region. But I am not aware that the subject is yet ripe for a Report. I need not remind you that the moon possesses neither sea nor atmosphere of appreciable extent. Still, as a negative, in such case, is relative only to the capabilities of the instruments employed, the search for the indications of a lunar atmosphere has been renewed with every fresh augmentation of telescopic power. Of such indications, the most delicate, perhaps, are those afforded by the occultation of a planet by the moon. The occultation of Jupiter, which took place on the 2nd of January last, was observed with this reference, and is said to have exhibited no *hesitation*, or change of form or brightness, such as would be produced by the refraction or absorption of an atmosphere. As respects the sea, the mode of examination long since suggested by Sir David Brewster is probably the most effective. If water existed on the moon's surface, the sun's light reflected from it should be completely polarized at a certain elongation of the moon from the sun. No traces of such light have been observed; but I am not aware that the observations have been repeated recently with any of the larger telescopes. It is now well understood that the path of astronomical discovery is obstructed much more by the earth's atmosphere than by the limitation of telescopic powers. Impressed with this conviction, the Association has, for some time past, urged upon Her Majesty's Government the scientific importance of establishing a large reflector at

some elevated station in the Southern Hemisphere. In the mean time, and to gain (as it were) a sample of the results which might be expected from a more systematic search, Prof. Piazzi Smyth undertook, last summer, the task of transporting a large collection of instruments—meteorological and magnetical, as well as astronomical—to a high point on the Peak of Teneriffe. His stations were two in number, at the altitudes above the sea of 8,840 and 10,700 feet respectively; and the astronomical advantages gained, may be inferred from the fact, that the heat radiated from the moon, which has been so often sought for in vain in a lower region, was distinctly perceptible, even at the lower of the two stations.

"The researches relative to the *Figure of the Earth* and the *Tides* are intimately connected with Astronomy, and next claim our attention. The results of the Ordnance Survey of Britain, so far as they relate to the earth's figure and mean density, have been lately laid before the Royal Society by Col. James, the Superintendent of the Survey. The ellipticity deduced is $\frac{1}{299 \cdot 33}$. The mean specific gravity of the earth, as obtained from the attraction of Arthur's Seat, near Edinburgh, is 5·316; a result which accords satisfactorily with the mean of the results obtained by the torsion balance. Of the accuracy of this important work, it is sufficient to observe, that when the length of each of the measured bases (in Salisbury Plain and on the shores of Lough Foyle) was computed from the other, through the whole series of intermediate triangles, the difference from the measured length was only 5 inches in a length of from 5 to 7 miles.

"Our knowledge of the laws of the *Tides* has received an important accession in the results of the tidal observations made around the Irish coasts in 1851, under the direction of the Royal Irish Academy. The discussion of these observations was undertaken by Prof. Haughton, and that portion of it which relates to the diurnal tides has been already completed and published. The most important result of this discussion is the separation of the effects of the sun and moon in the diurnal tide—a problem which was proposed by the Academy as one of the objects to be attained by the contemplated observations, and which has been now for the first time accomplished. From the comparison of these effects Prof. Haughton has drawn some remarkable conclusions relative to the mean depth of the sea in the Atlantic. In the dynamical theory of the tides, the ratio of the solar to the lunar effect depends not only on the masses, distances, and periodic times of the two luminaries, but also on the depth of the sea; and this, accordingly, may be computed when the other quantities are known. In this manner Prof. Haughton has deduced from the solar and lunar co-efficients of the diurnal tide, a mean depth of 5·12 miles—a result which accords in a remarkable manner with that inferred from the ratio of the semi-diurnal co-efficients, as obtained by Laplace from the Brest observations. The subject, however, is far from being exhausted. The depth of the sea, deduced from the solar and lunar *tidal intervals*, and from *the age* of the lunar diurnal tide, is somewhat more than double of the foregoing; and the consistency of the individual results is such as to indicate that their wide difference from the former is not attributable to errors of observation. Prof. Haughton throws out the conjecture that the depth, deduced from the tidal *intervals* and *ages*, orresponds to a different part of the ocean from that inferred from the *heights*.

"The phenomena of *terrestrial magnetism* present many close analogies with those of the tides; and their study has been, in a peculiar manner, connected with the labours of this Association. To this body, and by the hands of its present general secretary, were presented those reports on the distribution of the

terrestrial magnetic force which re-awakened the attention of the scientific world to the subject. It was in the Committee rooms of this Association that the first step was taken towards that great magnetic organization which has borne so much fruit. It was here that the philosophical sagacity of Herschel guided its earlier career; and it was here again that the cultivators of the science assembled, from every part of Europe, to deliberate about its future progress. It was natural, therefore, that the results obtained from such beginnings should form a prominent topic in the addresses which have been annually delivered from this chair; and the same circumstances will plead my excuse if I now revert to some of them which have been already touched upon by my predecessors. It has been long known that the elements of the earth's magnetic force were subject to certain regular and recurring changes, whose periods were, respectively, a *day* and a *year*, and which, therefore, were referred to the sun as their source. To these periodical changes Dr. Lamont of Munich, added another of *ten years:* the diurnal range of the magnetic declination having been found to pass from a maximum to a minimum and back again, in about that time. But besides these slow and regular changes, there are others of a different class, which recur at *irregular* intervals, and which are characterized by a large deviation of the magnetic elements from their normal state, and generally also by rapid fluctuation and change. These phenomena, called by Humboldt 'magnetic storms,' have been observed to occur *simultaneously* in the most distant parts of the earth, and thus to indicate a cause operating upon the entire globe. But, casual as they seem, these effects are found to be subject to laws of their own. Prof. Kreil was the first to discover that, at a given place, they recurred more frequently at certain hours of the day than at others; and that, consequently, in their mean effects, they were subject to periodical laws, depending upon the *hour* at each station. The laws of this periodicity have been ably worked out by General Sabine in his discussion of the results of the British Colonial Observatories; and he has added the important facts, that the same phenomena observe also the two other periods already noticed,—namely, the *annual* and the *decennial* periods. He has further arrived at the very remarkable result, that the decennial magnetic period coincides, both in its duration and in its epochs of maxima and minima, with the decennial period observed by Schwabe in the solar spots; from which it is to be inferred that the sun exercises a magnetic influence upon the earth dependent on the condition of its luminous envelope. We are thus in the presence of two facts, which appear at first sight opposed—namely the absolute simultaneity of magnetic disturbances at all parts of the earth, and their predominance at certain local hours at each place. General Sabine accounts for this apparent discrepancy by the circumstance, that the hours of maximum disturbance are different for the different elements; so that there may be an abnormal condition of the magnetic force, operating at the same instant over the whole globe, but manifesting itself at one place chiefly in one element, and at another place in another. I would venture to suggest, as a subject of inquiry, whether the phenomena which have been hitherto grouped together as 'occasional' effects may not possibly include two distinct classes of changes, obeying separate laws; one of them being strictly periodic, and constituting a part of the regular diurnal change; while the other is strictly abnormal, and simultaneous at all parts of the globe. If this be so, it would follow that we are not justified in separating the larger changes from the rest, merely on the ground of their magnitude, and that a different analysis of the phenomenon is required. The effects hitherto con-

sidered are all referable to the sun as their cause. Prof. Kreil discovered, however, that another body of our system—namely, our own satellite—exerted an effect upon the magnetic needle, and that the magnetic declination underwent a small and very regular variation, whose amount was dependent on the lunar hour angle, and whose period was therefore a lunar day. This singular result was subsequently confirmed by Mr. Broun in the discussion of the Makerstown Observations; and its laws have since been fully traced, for all the magnetic elements, by General Sabine, in the discussion of the results obtained at the Colonial Magnetic Observatories.

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"The most important step which has been recently taken in this country to advance the science of *Meteorology* has been the formation of a department connected with the Board of Trade, for the collection and discussion of meteorological observations made *at sea*. The practical results of a similar undertaking in the United States are now well known. The charts and sailing directions published by Lieut. Maury have enabled navigators to shorten their passages, in many cases by one-fourth of the time, and in some even to a greater extent. The commercial importance of such a result could not fail to attract general attention; and accordingly, when the United States Government invited other maritime nations to co-operate in the undertaking, the invitation was cordially accepted. A conference was held at Brussels in 1853, at which meteorologists deputed by those powers attended; and a Report was made, recommending the course to be pursued in a general system of marine meteorological observations. This Report was laid before the British Parliament soon after, and a sum of money was voted for the necessary expenditure. The British Association undertook to supply verified instruments by means of its Observatory at Kew; and the Royal Society, in consultation with the most eminent meteorologists of Europe and America, addressed an able Report to the Board of Trade, in which the objects to be attended to, so as to render the system of observation most available for science, were clearly set forth. With this co-operation on the part of the two leading scientific societies, the establishment was soon organized. It was placed under the direction of a distinguished naval officer, Admiral FitzRoy; and in the beginning of 1855 it was in operation. Agents were established at the principal ports for the supply of instruments, books, and instructions; and there are now more than 200 British ships so furnished, whose officers have undertaken to make and record the required observations, and to transmit them from time to time to the Department. The observations are tabulated, by collecting together, in separate books those of each month, corresponding to geographical spaces bounded by meridians and parallels 10 degrees apart. At the present time, 700 months of logs have been received from nearly 100 merchant ships, and are in process of tabulation. Holland is taking similar steps; and the Meteorological Institute of that country, under the direction of Mr. Buys Bellot, has already published three volumes of nautical information, obtained from Dutch vessels in the Atlantic and Indian Oceans. For the purposes of meteorological science, this system cannot be considered as complete until observations *on land* are included. Most of the greater atmospheric changes are due to the distribution of land and water, and to the different effects of the sun's rays on each Observation alone can furnish the data from which the effects of these agencies may be calculated; and we can therefore probably make no great advance in the knowledge of the meteorology of the globe, without a concurrent investigation of

its two leading departments. Land observations exist in great numbers. In Prussia, in Russia, in Austria, and in Belgium, such observations are organized under Government direction, or at least with Government support. In other parts of Europe, as in Britain, the labour is left to individuals or scientific Societies. What is needed is to give *unity* to these isolated labours—to connect them with one another, and with the results obtained at sea; and the first step to this seems to be to give them, in each country, that permanence and uniformity of system which can only be insured in measures adopted by the State.

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"The most important of the recent additions to the theory of *Light* have been those made by M. Jamin. It has been long known that metals differed from transparent bodies, in their action on light, in this, that plane-polarized light reflected from their surfaces became *elliptically polarized;* and the phenomenon is explained on the principles of the wave theory, by the assumption that the vibration of the ether undergoes a *change of phase* at the instant of reflexion, the amount of which is dependent on its direction and on the angle of incidence. This supposed distinction, however, was soon found not to be absolute. Mr. Airy showed that *diamond* reflected light in a manner similar to metals; and Mr. Dale and Prof. Powell extended the property to all bodies having a high refractive power. But it was not until lately that M. Jamin proved that there is *no distinction* in this respect between transparent and metallic bodies; that all bodies transform plane-polarized into elliptically-polarized light, and impress a change of phase at the moment of reflexion. Prof. Haughton has followed up the researches of M. Jamin, and established the existence of *circularly polarized* light by reflexion from transparent surfaces. The theoretical investigations connected with this subject afford a remarkable illustration of one of those impediments to the progress of natural philosophy which Bacon has put in the foremost place among his examples of the *Idola*—I mean the tendency of the human mind to suppose a greater simplicity and uniformity in nature than exists there. The phenomena of polarization compel us to admit that the sensible luminous vibrations are *transversal*, or in the plane of the wave itself; and it was naturally supposed by Fresnel, and after him by McCullagh and Neumann, either that no *normal* vibrations were propagated, or that, if they were, they had no relation to the phenomena of light. We now learn that it is by them that the *phase* is modified in the act of reflection; and that, consequently, no dynamical theory which neglects them, or sets them aside, can be complete. Attention has been lately recalled to a fundamental position of the wave-theory of light, respecting which opposite assumptions have been made. The vibrations of a polarized ray are all parallel to a fixed direction in the plane of the wave; but that direction may be either *parallel or perpendicular* to the plane of polarization. In the original theory of Fresnel, the latter was assumed to be the fact; and in this assumption Fresnel has been followed by Cauchy. In the modified theories of McCullagh and Neumann, on the other hand, the vibrations are supposed to be parallel to the plane of polarization. This opposition of the two theories was compensated, as respects the results, by other differences in their hypothetical principles; and both of them led to conclusions which observation has verified. There seemed, therefore, to be no means left to the theorist to decide between these conflicting hypotheses until Prof. Stokes recently, in applying the dynamical theory of light to other classes of phenomena, found one in which the effects should differ on the two assumptions. When light

is transmitted through a fine grating, it is turned aside, or *diffracted*, according to laws which the wave theory has explained. Now, Prof. Stokes has shown that, when the incident light is *polarized*, the *plane of vibration* of the diffracted ray must differ from that of the incident, the two planes being connected by a very simple relation. It only remained, therefore, for observation to determine whether the *planes of polarization* of the incident and refracted rays were similarly related, or not. The experiment was undertaken by Prof. Stokes himself, and he has inferred from it that the original hypothesis of Fresnel is the true one. But, as an opposite result has been obtained by M. Holzmann, on repeating the experiment, the question must be regarded as still undetermined. The difference in the experimental results is ascribed by Prof. Stokes to the difference in the nature of the gratings employed by himself and by the German experimentalist, the substance of the diffracting body being supposed to exert an effect upon the polarization of the light, which is diffracted by it under a great obliquity. I learn from Prof. Stokes that he proposes to resume the experimental inquiry, and to test this supposition by employing gratings of various substances. If the conjecture should prove to be well founded, it will greatly complicate the dynamical theory of light. In the mean time the hypothesis is one of importance in itself, and deserves to be verified or disproved by independent means.

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"In the whole range of experimental science there is no fact more familiar, or longer known, than the development of *Heat* by friction. The most ignorant savage is acquainted with it,—it was probably known to the first generation of mankind. Yet, familiar as it is, the science of which it is the germ dates back but a very few years. It was known from the time of Black, that heat disappeared in producing certain changes of state in bodies, and reappeared when the order of those changes was reversed; and that the amount of heat, thus converted, had a given relation to the effect produced. In one of these changes—namely, evaporation, a definite mechanical force is developed, which is again absorbed when the vapour is restored by pressure to the liquid state. It was, therefore, not unnatural to conjecture, that in all cases in which heat is developed by mechanical action, or *vice versa*, a definite relation would be found to subsist between the amount of the action and that of the heat developed or absorbed. This conjecture was put to the test of experiment by Mayer and Joule, in 1842, and was verified by the result. It was found that *heat* and *mechanical power* were *mutually convertible;* and that the relation between them was *definite*, 772 *foot-pounds* of motive power being equivalent to a *unit of heat*—that is, to the amount of heat requisite to raise a pound of water through one degree of Fahrenheit. The science of Thermodynamics, based upon this fact, and upon a few other obvious facts or self-evident principles, has grown up in the hands of Clausius, Thomson, and Rankine, into large proportions, and is each day making fresh conquests in the region of the unknown. Thus far the science of heat is made to rest wholly upon the facts of experiment, and is independent of any hypothesis respecting the molecular constitution of bodies. The dynamical theory of heat, however, has materially aided in establishing true physical conceptions of the *nature of heat*. The old hypothesis, of caloric, as a separate substance, was indeed rendered improbable by the experiments of Rumford and Davy, and by the reasonings of Young; but it continued to hold its ground, and is interwoven into the *language* of science. It is now clearly shown to be self-contradictory; and to lead to the result that the amount of heat

in the universe may be indefinitely augmented. On the other hand, the identification of radiant heat with light, and the establishment of the wave-theory, left little doubt that heat consisted in a *vibratory movement* either of the molecules of bodies or of the ether within them. Still, the relation of heat to bodies and the phenomena of conduction, indicate a mechanism of a more complicated kind than that of light, and leave ample room for further speculation. The only mechanical hypothesis (so far as I am aware) which is consistent with the present state of our knowledge of the phenomena of heat, is the theory of *molecular vortices* of Mr. Rankine. In this theory all bodies are supposed to consist of *atoms*, composed of *nuclei* surrounded with *elastic atmospheres*. The radiation of light and heat is ascribed to the transmission of oscillations of the nuclei; while *thermometric heat* is supposed to consist in circulating currents or *vortices*, amongst the particles of their atmospheres, whereby they tend to recede from the nuclei, and to occupy a greater space. From this hypothesis Mr. Rankine has deduced all the laws of thermo-dynamics, by the application of known mechanical principles. He has also, from the same principles, deduced relations (which have been confirmed by experiment) between the pressure, density and absolute temperature of elastic fluids, and between the pressure and temperature of ebullition of fluids. The dynamical theory of heat enables us to frame some conjectures to account for the continuance of its supply, and even to speculate as to its source. The heat of the sun is dissipated and lost by radiation, and must be progressively diminished, unless its thermal energy be supplied. According to the measurements of M. Pouillet, the quantity of heat given out by the sun in a year is equal to that which would be produced by the combustion of a stratum of coal seventeen miles in thickness; and if the sun's capacity for heat be assumed equal to that of water, and the heat be supposed to be drawn uniformly from its entire mass, its temperature would thereby undergo a diminution of 2°.4 Fahr. annually. On the other hand, there is a vast store of force in our system capable of conversion into heat. If, as is indicated by the small density of the sun, and by other circumstances, that body has not yet reached the condition of incompressibility, we have, in the future approximation of its parts, a fund of heat probably quite large enough to supply the wants of the human family to the end of its sojourn here. It has been calculated that an amount of condensation, which would diminish the diameter of the sun by only the ten-thousandth part, would suffice to restore the heat emitted in 2,000 years. Again, on our own earth, *vis viva* is destroyed by friction in the ebb and flow of every tide, and must therefore reappear *as heat*. The amount of this must be considerable, and should not be overlooked in any estimation of the physical changes of our globe. According to the computation of Bessel, 25,000 cubic miles of water flow in every six hours from one quarter of the earth to another. The store of mechanical force is thus diminished and the temperature of our globe augmented by every tide. We do not possess the data which would enable us to calculate the magnitude of these effects. All that we know with certainty is, that the *resultant effect* of all the thermal agencies to which the earth is exposed has undergone no perceptible change within the historic period. We owe this fine deduction to Arago. In order that the *date palm* should ripen its fruit, the mean temperature of the place must exceed 70° Fahr.; and, on the other hand, the *vine* cannot be cultivated successfully when the temperature is 72° or upwards. Hence, the mean temperature of any place at which these two plants flourished and bore fruit must lie between these narrow

limits, *i. e.* could not differ from 71° Fahr. by more than a single degree. Now, from the Bible we learn that both plants were *simultaneously* cultivated in the central valleys of Palestine in the time of Moses; and its then temperature is thus definitively determined. It is the same at the present time; so that the mean temperature of this portion of the globe has not sensibly altered in the course of thirty-three centuries.

"The future of physical science seems to lie in the path upon which three of our ablest British physicists have so boldly entered, and in which they have already made such large advances. I may, therefore, be permitted briefly to touch upon the successive steps in this lofty generalization, and to indicate the goal to which they tend. It has been long known that many of the forces of nature are related. Thus, heat is produced by *mechanical action*, when that is applied in bringing the atoms of bodies nearer by compression, or when it is expended in friction. Heat is developed by *electricity*, when the free passage of the latter is impeded. It is produced whenever *light is absorbed*; and it is generated by *chemical action.* A like interchangeability probably exists among all the other forces of nature, although in many the relations have not been so long perceived. Thus, the development of electricity from chemical action dates from the observations of Galvani; and the production of magnetism by electricity from the discovery of Oersted. The next great step was to perceive that the relation of the physical forces was *mutual;* and that of any two, compared together, either may stand to the other in the relation of *cause.* With respect to heat and mechanical force, this has been long known. When a body is *compressed* by mechanical force, it gives out *heat;* and, on the other hand, when it is *heated*, it dilates, and evolves *power.* The knowledge of the action of electricity in dissolving the bonds of chemical union followed closely upon that of the inverse phenomenon; and the discovery of *electro-magnetism* by Oersted was soon followed by that of *magneto-electricity* by Faraday. With reason, therefore, it occurred to many minds that the relations of any two of the forces of nature were *mutual*—that that which is the *cause*, in one mode of interaction, may become the *effect*, when the order of the phenomena is changed;—and that, therefore, in the words of Mr. Grove, one of the able expounders of these views, while they are "correlative," or reciprocally dependent, "neither, taken abstractedly, can be said to be the essential cause of the other." But a further step remained to be taken. If these forces were not only related, but mutually related, was it not probable that the relation was also a *definite* one? Thus, when heat is developed by mechanical action, ought we not to expect a certain definite proportion to subsist between the interacting forces, so that if one were doubled or trebled in amount, the other should undergo a proportionate change? This anticipation, it has been already stated, has been realized by Mayer and Joule. The discovery of the mechanical equivalent of heat has been rapidly followed by that of other forces; and we now know not only that electricity, magnetism, and chemical action, in given quantities, will produce each a *definite amount of mechanical work*, but we know further—chiefly through the labours of Joule—what that relation is, or, in other words, *the mechanical equivalent of each force.* The first step in this important career of discovery—though long unperceived in its relation to the rest—was, undoubtedly, Faraday's great discovery of the definite chemical effect of the voltaic current. The last will probably be to reduce all these phenomena to *modes of motion*, and to apply to them the known principles of dynamics, in such a way as not only to express

the laws of each kind of movement, as it is in itself, but also the connexion and dependence of the different classes of the phenomena.

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"The science of *Geology* appears, of late years, to have entered upon a new phase of its development,—one characterized by a stricter reference of its speculative views to the principles of those sciences with which it is connected, and upon which it ought to be based. We have an example of this in the able Memoirs of Mr. Hopkins, on what may be called *Dynamical Geology*, including the changes which have taken place in the earth's crust by the operation of internal forces. Another instance of application of sound physical principles to this science is found in the explanations which have been recently offered of the phenomena of *slaty cleavage*. A report on this interesting subject was presented to the Association by Prof. Phillips at its last meeting, and will be found in the volume just published. These sounder views originate, I believe, with himself and with Mr. Sharpe; but they have been enlarged and confirmed by Mr. Sorby, Dr. Tyndall, and Prof. Haughton. We have another interesting proof of the readiness of geologists of the present day to submit their views to the test of exact observation, in the measurements undertaken by Mr. Horner for the purpose of approximating to the age of sedimentary deposits. Of the geological changes still in operation, none is more remarkable than the formation of deltas at the mouths of great rivers, and of alluvial land by their overflow. Of changes of the latter kind, perhaps the most remarkable is the great alluvial deposit formed in the valley of the Nile by the annual inundations of that river; and here it fortunately happens that history comes to the aid of the geologist. These sedimentary deposits have accumulated round the bases of monuments of *known age;* and we are, therefore, at once furnished with a *chronometric scale* by which the rate of their formation may be measured. The first of the series of measurements undertaken by Mr. Horner was made with the co-operation of the Egyptian Government, around the obelisk of Heliopolis, a monument built, according to Lepsius, 2300 years B. C. A more extensive series of researches has been since undertaken in the district of Memphis; but Mr. Horner has not yet, I believe, published the results. The problems now to be solved in *Palæontology* are clearly defined in the enunciation of the problem recently proposed by the French Academy of Sciences as one of its prize questions, viz.: 'to study the laws of distribution of organic beings in the different sedimentary rocks, according to the order of their superposition; to discuss the question of their appearance or disappearance, whether simultaneous or successive; and to determine the nature of the relations which subsist between the existing organic kingdom and its anterior states.' The prize was obtained by Prof. Bronn, of Heidelberg; and his memoir, of which I have only seen an outline, appears to be characterized by views at once sound and comprehensive. The leading result seems to be, that the genera and species of plants and animals, which geology proves to have existed successively on our globe, were *created in succession*, in adaptation to the existing state of their abode, and *not transmuted* or *modified*, as the theory of Lamarck supposes, by the physical influences which surrounded them."

Having embraced in his address a review of some of the most remarkable evidences of recent progress in science, Dr. Lloyd devoted the concluding portion of his speech to the administrative measures of the Association, in so far as these have a direct bearing on the advancement of its highest objects. The steps already

taken for the preparation of a catalogue of papers occurring in the Transactions of the Scientific Societies and in Scientific Journals, were noted by him, and commended to the attention of the General Committee. The still more important subject of guiding the influence of the British Government and of Parliament, for improving the position of British Science, and advancing the just interests and claims of its students, next occupied his attention. The establishment of a Scientific Board for the control and expenditure of the public funds devoted to science; and the provision of a central National Building in the British Metropolis, for the meetings and other requirements of the principal Scientific Societies, were specially noted by the President, as objects now aimed at, and towards the accomplishment of which Her Majesty's Government have evinced a gratifying readiness to render every aid consistent with the other claims, which war and rebellion have recently made so preeminent.

Finally, Dr. Lloyd congratulated the Association on the extension of their field of labours, by the enlargement of the scope of the statistical section so as to embrace economic science in all its relations; and concluded in these words: "I am conscious that the sketch of the recent progress of the Physical Sciences, which I have endeavoured to present, is but a meagre and imperfect summary of what has been accomplished; but it is enough, at all events, to prove that science is not on the decline, and that its cultivators have not been negligent in their high calling. I now beg in the name of the local members of this body, to welcome you warmly to this city; and I pray that your labours here may redound to the glory of God, and to the welfare and happiness of your fellow-men."

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Among the features of the American Scientific Congress, in the Capitol at Albany, last year, which were felt alike by Americans and Strangers as giving a novel interest to that meeting, was the Canadian deputation sent to invite the representatives of the Science of the United States to step beyond their political bounds, and accept the hospitality of Montreal. Other, and older claims were at the same time advanced. Baltimore was especially urgent, and refused to hear of delay; but a spirit of liberal cosmopolitanism prevailed, and the invitation was accepted, which has this year enabled us to witness the honored veterans of American Science welcomed with no stinted cordiality to the chief city of the Canadas, the commercial metropolis of British America. The duties which thereby devolved on the citizens of Montreal, and on the Province at large, were neither few nor trivial; and to most of these duties past experience could lend us little aid. Nevertheless, what hearty earnestness and cordial good-will could accomplish was done; and though the occasion may not have passed off without some of those little jealousies and slights to which all such large and miscellaneous congresses are everywhere liable, we have reason to believe that the general impression remaining on the minds of those who took a part in the meeting, is one of unalloyed pleasure; while the conviction has been frankly expressed by those longest and most intimately conversant with the proceedings of the American Association, that the success of the meeting was as gratifying to the assembled representatives of American Science, as it was creditable to the citizens of Montreal.

The opening meeting was graced by proceedings of a cordial and hearty geniality, well suited to the occasion. His Excellency, Sir William Eyre, the Administrator of the Government, occupied the right hand of the chair. The lamented death of the President elect, Professor Bailey, devolved the inaugural duties on the Vice-President, Professor Caswell; and his graceful urbanity, ready tact, and conciliatory equanimity, were felt not only on this occasion, but throughout the meeting, to contribute not a little to the uninterrupted harmony which constituted one of the chief elements of its success. Professor Hall, of Albany, the retiring President, having introduced Professor Caswell, resigned the chair to him; and the new President thereupon proceeded to address the members of the Association, congratulating them on the large attendance, and the happy circumstances under which they there met. "It augurs well for the interests of Science," he observed, "that so many have come here to place their choicest contributions on her altar, and to welcome to her fellowship the humblest laborer in her cause. I think also, that it is a matter of congratulation that we have met beyond the limits of the United States. However it may have been in former times, it is not now the case that:—

> "Lands intersected by a narrow frith
> Abhor each other; or mountains interposed
> Make enemies of nations."

It is one of the felicities of our time, that in the onward march of Science, little account is taken of the boundaries that separate states and kingdoms. The discoverer of a new law or principle in nature, of a new process in the arts, or a new instrument of research, is speedily heralded over land and ocean; is welcomed as the benefactor of his race; and is immediately put into communication with the whole civilized world. We have before us a practical illustration of the amenities of science. We of the United States are here convened on British soil, little thinking that we have passed the boundary of the protection of American law, or that amidst the generous hospitality of this enterprising commercial capital of a noble Province of Great Britain, we are aliens to the British constitution. We have left the American eagle, but we feel in no danger of being harmed by the British lion. I have said that we are aliens to the British constitution; but that must be taken in the narrowest and most technical sense, for I am proud to say, on deliberate conviction, that nothing is alien to the British constitution that looks to the perfection of knowledge, to the furtherance of the arts or the amelioration of the condition of humanity. And, further, the proudest achievements of British arms,—and they have been proud enough for the highest desires of ambition or of glory,—have been less glorious than that generous patronage of science, that success in the arts, and those efforts to improve the condition of our race, which have placed Old England in the van of the nations; and at no period of her long history has that patronage been more wisely directed, or those noble efforts more earnestly persevered in, than under the reign of the present illustrious sovereign, whose virtues are alike the ornament of her sex and her crown."

Addresses of welcome were then delivered by His Excellency, the Administrator of the Government, on behalf of the Province; by Sir William Logan, for the Local Committee and the citizens of Montreal; and by Dr. Dawson, the Principal of McGill College, as President of the Natural History Society.

To those who are familiar with the recognised sectional divisions which so largely contribute alike to the interest and the efficiency of the British Association, the

desire manifested by the American men of Science to maintain as nearly as possible an undivided action throughout, is only less surprising than their transference to a daily General Meeting, so many questions of detail which we have been accustomed to see disposed of by a Committee. In the British Association there are now seven sections in full and efficient operation; while the American Association,—divided till last year only into a Natural History and a Physical Science Section, required that the Ethnologists, when craving at this meeting a separate one for themselves, should produce ten papers ready for reading before they could even be allowed to organise themselves into a dependent sub-section. Nevertheless it was apparent that materials were not wanting for a much more extensive organization of sections and classification of subjects; as indeed became abundantly manifest when chemistry, statistics, and political economy, all claimed to be received by the Ethnological sub-section, as orphan sciences elsewhere unprovided for. Nothing, we believe, would be found more calculated to increase at once the popular interest and the practical efficiency of the Association, than its subdivision into more numerous sections for daily work. It would indeed of necessity diminish the crowd of miscellaneous auditors. But to compel the Chemist to submit his papers to an impatient auditory of Geologists, or the Political Economist or Statistician to intrude himself on unwilling Ethnologists, is to impede the work of all, and to drive the intruding sciences to seek a heartier recognition on some other arena. Some of the characteristics which specially distinguish the organization and procedure of the American Association, are undoubtedly traceable to the circumstances in which it originated. Formed at first solely as an Association of American Geologists, the other sciences have been admitted into favour chiefly in so far as they had a bearing on the favorite study; and hence its Natural History has been to a great extent palæontological; its Chemistry has been mineralogical or atmospheric; and Physics with Mathematics have alone heretofore secured an independent footing.

The address of the retiring President, Professor Hall, was devoted exclusively to the elucidation of his views on some novel but highly interesting questions in his own favorite science of Geology. In this he presented at great length, and with much ability, very comprehensive generalizations relative to the rise of continents, the direction and influence of currents of deposition, and the causes in operation in the formation of mountain chains. This address was originally delivered at a Conversazione given to the members of the Association by the Natural History Society of Montreal in the Bonsecours Hall. But, notwithstanding the chivalrous promptness with which the American asserts the rights and the intellectual equality of woman, it was felt by the more enthusiastic devotees of science that the gay assembly of ladies which graced the entertainment supplied an audience who might not perchance enter with all their enthusiasm into the abstruse geological questions they were challenged to discuss. Some slight dissatisfaction was accordingly expressed by a few of the more eager militant geologists who, while longing to break a lance in the lists, were too much bent on the combat *a l'outrance*, to look with favor on bright eyes and fair faces crowding the arena. The difficulty was at length solved by Professor Hall being invited to re-deliver his address before the general meeting on a subsequent day. Its length, however, precluded the desired discussion even then; and we regret the impossibility of embracing any adequate epitome of its comprehensive generalizations within the limits at our command.

SECTION OF GEOLOGY AND NATURAL HISTORY.

ON THE VARIETIES AND MODE OF PRESERVATION OF THE FOSSILS KNOWN AS STERNBERGIÆ—BY J. W. DAWSON, LL.D., PRINCIPAL OF M'GILL COLLEGE, MONTREAL.

The fossils which have been named Sternbergiæ and sometimes Artisiæ, are usually mere casts in clay or sand, having a transversely wrinkled surface, and sometimes an external coaly coating and traces of internal coaly partitions. They are found in the coal formation rocks of most countries, and very abundantly in those of Nova Scotia. Until the recent discoveries of Corda and Williamson, they were objects of curious and varied conjecture to geologists and botanists, and were supposed to indicate some very extraordinary and anomalous vegetable structure. They are now known to be casts of the piths or internal medullary cavities of trees, and the genera to which some of them belong have been pointed out. In the present paper I propose to offer some further contributions toward their history, and the geological inferences deducible from it.

In a paper communicated to the Geological Society of London, in 1846, I stated my belief that those specimens of Sternbergiæ which occur with only thin smooth coatings of coal, belonged to rush-like endogens ; while those to which fragments of fossil wood were attached, presented structures resembling those of conifers. Additional specimens affording well-preserved coniferous tissue, in connection with others in a less perfect state of preservation, have enabled me more fully to comprehend the homologies of this curious structure, and the manner in which specimens of it have been preserved independently of the wood.

My most perfect specimen is one from the coal field of Pictou, cylindrical but somewhat flattened. The diaphragms or transverse partitions appear to have been continuous, though now somewhat broken. They are rather less than one-tenth of an inch apart, and are more regular than is usual in these fossils. The outer surface of the pith, except where covered by the remains of the wood, is marked by strong wrinkles, corresponding to the diaphragms. The little transverse ridges are in part coated with a smooth tissue similar to that of the diaphragms, and of nearly the same thickness. In its general aspect, the specimen perfectly resembles many of the ordinary marked Sternbergiæ.

On microscopic examination the partitions are found to consist of condensed pith, which, from the compression of the cells, must have been of a firm bark-like texture in the recent plant. The wood attached to the surface is distinctly coniferous, with two and three rows of discs on the cell walls. It is not distinguishable from that of Witham, or from the specimens figured by Professor Williamson. The wood and transverse partitions are perfectly silicified, and of a dark brown colour. The partitions are coated with small colourless crystals of quartz and little iron pyrites, and the remaining spaces are filled with crystalline laminæ of sulphate of barytes.

Unfortunately this fine specimen does not possess enough of its woody tissue to show the dimensions or age of the trunk or branch which contained this enormous pith. It proves, however, that the pith itself has not been merely dried and cracked transversely by the elongation of the stem, as appears to be the case in the Butternut, (*Juglans Cinerea*,) and some other modern trees; but that it has been condensed into a firm epidermis-like coating and partitions, apparently less destructible than the woody tissue which invested them. In this specimen the

process of condensation has been carried much farther than in that described by Professor Williamson, in which a portion of the unaltered pith remained between the Sternbergia-cast and the wood. It thus more fully explains the possibility of the preservation of such hollow chambered piths, after the disappearance of the wood. It also shows that the coaly coating investing such detached pith casts is not the medullary sheath, properly so called, but the outer part of the condensed pith itself.

The examination of this specimen having convinced me that the structure of Sternbergiæ implies something more than the transverse cracking observed in Juglandaceæ, I proceeded to compare it with other piths, and especially with that of Cecropia Peltata, a West Indian tree, of the natural family Artocarpaceæ. This recent stem is two inches in diameter. Its medullary cylinder is three-quarters of an inch in diameter, and is lined throughout by a coating of dense whitish pith tissue, one-twentieth of an inch in thickness. This condensed pith is of a firm corky texture, and forms a sort of internal bark lining the medullary cavity. Within this the stem is hollow, but is crossed by arched partitions, convex upward. These partitions are of the same white corky tissue with the pith lining the cavity; and on their surfaces, as well as on that of the latter, are small patches of brownish large-celled pith, being the remains of that which has disappeared from the intervening spaces.

Inferring from these appearances that this plant contains two distinct kinds of pith tissue, differing in duration and probably in function, I obtained, for comparison, specimens of living plants of this and allied families. In some of these, and especially in a "Ficus Imperialis," from Jamaica, I found the same structure; and in the young branches, before the central part of the pith was broken up, it was evident that the tissue was of two distinct kinds—one forming the outer coating and transverse partitions opposite the insertions of the leaves, and retaining its vitality for several years at least; the other occupying the intervening spaces or internodes, of looser texture, speedily drying up, and ultimately disappearing.

Another variety of the Sternbergia-like pith structure appears in a rapidly growing exogenous tree with opposite leaves, cultivated here, and I believe a species of Paullinia. In this trunk there are thick nodal partitions, and the intervening spaces are hollow and lined with firm corky pith, with its superficial portion condensed into a sort of epidermis, and marked with transverse wrinkles; a cast of which would resemble those Sternbergiæ which have merely wrinkles without diaphragms.

The trunks above noticed are of rapid growth, and have large leaves; and it is probable that the more permanent pith tissue of the medullary lining and partitions serve to equalize the distribution of the juices of the stem, which might otherwise be endangered by the tearing of the ordinary pith in the rapid elongation of the internodes. A similar structure has evidently existed in the coal formation conifers of the genus Dadoxylon, and possibly they also were of rapid growth, and furnished with very large or abundant leaves.

Applying the facts above stated to the different varieties or species of sternbergia, we must in the first place connect with these fossils such plants as the Pinites Medullaris of Witham. All are distinctly coniferous, and the differences that appear may be due merely to age, or more or less rapid growth.

Other specimens of sternbergia want the internal partitions, which may, however, have been removed by decay; and these often retain very imperfect traces,

or none, of the investing wood. In the case of those which retain any portion of the wood, sufficient to render probable their coniferous character, the surface-markings are similar in character to those of my Pictou specimen, but often vary greatly in their dimensions, some having fine transverse wrinkles, others having these wide and coarse. Of those specimens which retain no wood, but only a thin coaly investment representing the outer pith, many cannot be distinguished by their superficial markings from those that are known to be coniferous, and they occasionally afford evidence that we must not attach too much importance to the character of their markings.

The state of preservation of the sternbergia casts in reference to the woody matter which surrounded them, presents, in a geological point of view, many interesting features. Frequently, only fragments of the wood remain, in such a condition as to evidence an advanced state of decay; while the bark-like medul, lary lining remains. In other specimens the coaly coating investing the cast-sends forth flat expansions on either side, as if the sternbergia had been the mid-rib of a long thick leaf. This appearance, at one time very perplexing to me, I suppose to result from the entire removal of the wood by decay, and the flattening of the bark, so that a perfectly flattened specimen may be all that remains of a coniferous branch nearly two inches in diameter. A still greater amount of decay of woody tissue is evidenced by those sternbergia casts which are thinly coated with structureless coal. These must, in many cases, represent trunks and branches which have lost their bark and wood by decay; while the tough, cork like, chambered pith drifted away to be imbedded in a separate state. This might readily happen with the pith of Cecropia; and perhaps that of these coniferous trees may have been more durable; while the wood, like the sap wood of many modern pines, may have been susceptible of rapid decay, and liable, when exposed to alternate moisture and dryness, to break up into those rectangular blocks, which are seen in the decaying trunks of modern conifers, and are so abundantly scattered over the surfaces of coal and its associated beds in the form of mineral charcoal.

Some specimens of sternbergia appear to show that they have existed in the interior of trunks of considerable size. The best instance of this that I have found is one from the South Joggins, which appears to show the remains of a tree a foot in diameter, now flattened and converted into coal, but retaining a distinct cast of a wrinkled sternbergia pith.

Are we to infer from these facts that the wood of the trees of the genus Dadoxylon was necessarily of a lax and perishable texture? Its structure, and the occurrence of the heart wood of huge trunks of similar character in a perfectly mineralized condition, would lead to a different conclusion; and I suspect that we should rather regard the mode of occurrence of sternbergia as cautioning against the too general inference from the state of preservation of trees of the coal formation, that their tissues were very destructible, and that the beds of coal must consist of such perishable materials. The coniferous character of the sternbergiæ, in connection with their state of preservation, seem to strengthen a conclusion at which I have been arriving from microscopic and field examinations of the coal and carbonaceous shales, that the thickest beds of coal, at least in Eastern America, consist in great part of the flattened bark of coniferous, sigillaroid and lepidodendroid trees, the wood of which has perished by slow decay, or appears only in the state of fragments and films of mineral charcoal. This is a view, however, on

which I do not now wish to insist, until I have further opportunities of confirming it by observation.

The most abundant locality of sternbergia, with which I am acquainted, occurs in the neighbourhood of the town of Pictou, immediately below the bed of erect calamities described in the Journal of the Geological Society. The fossils are found in interrupted beds of very coarse sandstone, with calcareous concretions, imbedded in a thick reddish brown sandstone. These gray patches are full of well preserved calamites, which have either grown upon them, or have been drifted in clumps with their roots entire. The appearances suggest the idea of patches of gray sand rising from a bottom of red mud, with clumps of growing calamites which arrested quantities of drift plants, consisting principally of sternbergia and fragments of much decayed wood and bark, now in a state of coaly matter too much penetrated by iron pyrites to show its structure distinctly. We thus probably have the fresh growing calamites, entombed along with the debris of the old decaying conifers of some neighbouring shore ; furnishing an illustration of the truth that the most ephemeral and perishable forms may be fossilized and preserved, contemporaneously with the decay of the most durable tissues. The rush of a single summer may be preserved with its minutest striæ unharmed, when the giant pine of centuries has crumbled into mould. It is so now, and it was so equally in the carboniferous period.

ON FLEXURE OF STRATA IN THE BROAD-TOP COAL FIELD, PENNSYLVANIA.

BY J. P. LESLIE.

In introducing the subject, Mr. Leslie stated that it had only recently come under his notice, and required more consideration for the full elucidation of all the truths which the phenomena he had to refer to tended to illustrate. Meanwhile it was of importance to call the attention of scientific geologists to such a remarkable example of flexure of strata as he had now to describe. Accordingly, availing himself of an opportunity so favorable, he had prepared a diagram of the appearance which these flexures presented, and although not so able to illustrate the aspect in question as he desired to have been, the subject represented a single fact to which he wished meanwhile to draw the attention of the Association. The diagram represented a section of the only coal bed in the broad-top region worked to any extent. He had obtained the section by studying that bed in eight or ten entries. The principal facts of the case, and patent to observation, were these: The bed itself is seven or eight feet thick, nine feet at its thickest portions, and seldom becomes less than five feet. In working this bed the greatest difficulties have been met with, in the shape of these flexures. Such details are rarely witnessed elsewhere in any consecutive series. Single instances have been found in innumerable places, but here they ocur in consecutive series, presenting a curious difficulty to the practical miner. The form which these flexures present amid their involutions, may be described as running up in an angular position, and becoming steeper and steeper, until they finally appear to "run out." But on examination, it is found that the top shale turns upon itself, and becomes the bottom of the flexure, with a perfectly even surface, and without any fracture. In this case, the miner is at a loss to discover where to go, and there exists no trace of the coal upwards through the rock. The appearance which these present, Mr. Leslie stated, is beautifully illustrated by a specimen which Sir William Logan has in his cabinet, derived from a Canadian locality, where it may be usefully

studied by any person desirous of examining the subject. In the construction of these flexures, side-pressure is the only thing that can be thought of. A slow steady irresistible pressure seems to have been brought to bear upon the rock, alternately hard and soft, so that when brought around upon each other the soft ones have been obliged to yield to the hard ones. The bed of coal alluded to is within 100 feet of the top of the old conglomerate. Above the top shales there is a mass of fine-grained sand-stone. But the effect as exhibited in these flexures could not have been so great, but for the fact that immediately below there is a bed of fine white clay, thirty or forty feet thick. How much of these flexures are the result of the forcing forward of this fine clay is one of the practical questions to which future observations must be directed.

The seams below the one now referred to have never been opened, and accordingly have not been studied, so that it is impossible to say whether these flexures correspond with those underneath. This is unfortunate, meanwhile, because one of the questions which the practical geologist is most anxious to have solved, is how far this pressure carries itself forward in vertical lines. But as the progress of mining operations will tend to effect the desired exposure of the lower strata, geologists may be glad to have their attention directed to the subject thus early.

SUBSIDENCE OF THE LAND ON THE NEW JERSEY COAST.—BY PROFESSOR G. H. COOK, OF RUTGER'S COLLEGE.

In the course of some geological examinations near the coast of Southern New Jersey, the author's attention had been called to various facts indicating a change in the relative level of the land and water at some recent period. An attentive examination of these led him to the conclusion that a gradual subsidence of the land is now in progress throughout the whole length of New Jersey and of Long Island; and from information derived from others, he was induced to think that this subsidence might extend along a considerable portion of the Atlantic coast of the United States. The occurrence of timber in the marshes and water, below tide-level, is common along their whole Atlantic shore. Almost every one familiar with shore-life had observed the remains of logs, stumps, and roots, in such places, although they had been looked upon generally as the remains of trees torn from their original place of growth by torrents, or by the necessary moving of the shores, and deposited in the places where they were found, by the ordinary action of the water. But close examination made it evident that they grew upon the spots where they are found. The stumps remain upright—their roots are still fast in the firm loamy ground which underlies the marsh, and their bark and small roots remain attached to them. The localities in which they are most abundant are such as are least liable to be affected by the violent action of the water, or of storms. Thus they are by far the most abundant on the low and gently sloping shores of Long Island, New Jersey, and all the States farther South which are protected from the violent action of the surf by a line of sand beaches, at the same time that the numerous inlets allow free access to the tides. In these protected situations hundreds and even thousands of acres can be found in which the bottom of the marshes and bays is as thickly set with the stumps of trees as is the ground of any living forest. His own observations were chiefly made upon the southern part of New Jersey, following the shores of Delaware Bay from its head down to Cape May, and the Atlantic shore from Cape May north to Great Egg Harbor,

and thence eastward at several points along the south shore of Long Island. In the ditches in the marshes, above Salem, great numbers of the stumps and trunks of trees are met with at all depths, down to the solid ground. At Elsinboro' Point, a little farther down on the Delaware Bay shore, the cutting away of the marsh by the water has left great numbers of stumps exposed, where they can be seen at every low tide still firmly rooted in the hard ground. They are also common in all the marshes of Cumberland County, and great numbers of them can be seen in the marshes on Main River, at Dorchester and below. In Cape May County they are seen everywhere in the marshes and the creeks, on the Delaware Bay; on the inside of Seven Mile Beach, on the sea side; and below Luckahoe, on Great Egg Harbour. In the marsh on the Raritan, above South Amboy, hundreds of them were dug out in cutting a canal across a bend in South River. The marshes on Staten Island also contain buried timber; and on Long Island, at Hempstead, and still further east, the same fact is of constant occurrence. At several places in Southern New Jersey an enormous quantity of white cedar timber is found buried in the salt marshes—sound and fit for use, and a considerable business is carried on in mining this timber and splitting it into shingles for market. At Dennisville there is a large tract of marsh underlaid by cedar swamp, earth and timber. By probing the marsh with an iron rod, the workmen find where the solid timber lies, and then removing the surface sods and roots, they manage to work in the mud and water with long one-handed saws and cut off the logs, which then rise and float, as the timber is not water-logged at all, but retains its buoyancy, and the removal of that nearest the surface releases that which is below and it rises in turn, so that a new supply is constantly coming up to the workmen. In this way a single piece of swamp which is below tide-level has been worked for fifty years past, and still gives profitable returns.

Other facts tend to the same conclusions. The owner of an extensive tract of land, between Maurice River and West Creek, informed the author that within the last fifty years he had lost 1,000 acres of timber by the tides running higher on the upland than they formerly did. On West Creek he was shown portions of upland on which good crops of wheat had been raised, within thirty years, which are now liable to be overrun by the tides. The same farm has, within the last fifty years, lost fifty acres—part wood and part cultivated land—in the same way, and taking into account all the evidence noted by himself, or set forth by others who had directed their attention to the subject, he could find no other theory which would embrace all the facts, than that of a slow and continued subsidence of the ground.

In regard to the rate at which this subsidence was going on, Professor Cook quoted the result of several examinations—three of a subsidence of three feet in 150 years, one of two feet in 100 years, two of one foot in fifty years,—and one of four inches and one of eight inches in two years. From these facts he conceived he might, with some degree of probability, set the average subsidence in the district where the observations were made, at two feet in a century, and he believed that this would also apply to all the observations yet made on the New England coasts.

ON PARTHENOGENESIS OF ANIMALS AND PLANTS—BY B. SEEMANN, F.L.S.

One of the most paradoxical questions, recently brought under the notice of men of science, is that known as the Parthenogenesis of Animals and Plants.

The belief in a Parthenogenesis or *Lucina sine concubitu* is by no means of recent growth, but has arrested the attention of mankind since the earliest ages. In diving into the writings of the Classics, and studying the mythology of the Greeks, it will be found more than once indicated; and in searching the pages of ancient naturalists of a subsequent period, the subject frequently meets our eye; but the observations upon which such statements were founded, are of no value for the purpose of modern science.

It is different with the publications that in more recent times have been forced upon our attention, and which, having been made with all the caution, circumspection and accuracy demanded by modern criticism, have in the opinion of many eminent naturalists, completely established the fact, that there exist occasionally individual females of both animals and plants, which, in a state of virginity are able to propogate their respective species. We have no modern observations proving the existence of a *Lucina sine concubitu* in any of the higher animals,—at least I am not aware of any,—but few are inclined to doubt that Professor Von Siebold's works, " On Parthenogenesis in Moths and Bees," have set this question at rest as regards Insects. It is well known that Professor Richard Owen, applied the term Parthenogenesis, some years ago, to the non-sexual reproduction observable in the genus Aphis, but that process being merely one of gemmation, a budding process, equivalent to what we see in the sprouting of a plant, it is now generally rejected, and Siebold and others always understand by Parthenogenesis the *Lucina sine concubitu* of ancient Naturalists, and therefore lay great stress upon the distinction of true Parthenogenesis and alternation of generation. Siebold, by carefully investigating the observations on Parthenogenesis in Insects, made by former naturalists, arrived at the conclusion that these observers were not sufficiently guarded against possible deceptions, and that entomologists had better reject them as inconclusive. He then shows that a true Parthenogenesis does undoubtedly exist in Psyche Helix, Solenobia clathrella, and lichenella, in Bombyx Mori, and Apis mellifica, (the Honey-bee,) but is of opinion that it occurs among insects in a much greater degree than we are at present able to prove. He places in this category the observations of Leon Dufour, that he never was able to obtain a male Diplolepis gallæ tinctariæ, and alludes to the statement of Hartig, who examined 9,000 to 10,000 individuals of Cynips divisa, and about 4,000 of Cynips folii, without ever finding among them a single male. The peculiar kind of reproduction observable in the lower Crustaceæ, which some have attempted to explain as alternation of generation or gemmation, may prove on closer investigation to be a true Parthenogenesis. Amongst the Molluscs there are also certain phenomena, which may possibly be explained as phases of a true Parthenogenesis. These allusions sufficiently show that the catalogue of reproduction in animals by means of Parthenogenesis, may be expected to receive considerable additions; whilst the doctrine hitherto generally received, that the developement of the ovum could take place solely under the direct influence of the male principle, has received a shock from which it is not likely to recover.

In the vegetable kingdom, authentic proofs of the existence of a Parthenogenesis are much more abundant than they are in the animal. Spallanzani, seems to have been the first who, towards the close of the last century, pointed out that the female hemp did produce ripe seeds without the aid of pollen; but his statement, though confirmed by the experiments of Bernhardi, met with so much opposition that it could not obtain the acknowledgment due to it; and it is only

the recent observations of Naudin in Paris, which, by confirming it still more, have at last vindicated for it the character of an accurate and strictly correct observation. Nor is it to be wondered at, that a fact, opposed to so many theories looked upon as true laws of nature, should have been received with the greatest distrust, and been, ex-cathedra, absolutely denied. That subjective deception should somewhere have taken place was a thought that readily suggested itself, as a plausible excuse for disbelieving so astounding a fact. How easy for polygamous flowers to be hidden among the female ones! (as Mr. Masters has shown them to exist occasionally in the dioicious hop plant.) How easy for pollen to be wafted to the stigmas! These and others were the objections of the unbelievers in the new discovery. To this must be added that the experiments of Koelreuter on hybrids, placed the sexuality of plants on a firmer footing than it formerly enjoyed, and that the concession that a dioicious plant could, under certain circumstances, develope its ovula without the aid of pollen, was looked upon as an absolute negation of sexuality.

The polemic on this subject was continued for many a year, but for the want of new observations began also to slacken, when on the 18th June, 1839, Mr. John Smith, Curator of the Royal Botanic Gardens at Kew, announced before the Linnean Society of London that there existed in the Royal Gardens a female specimen of a Euphorbiaceous plant, Cælebogyne ilicifolia, from New Holland, which annually produced ripe seeds without the aid of pollen. Robert Brown Lindley, the two Hookers, myself and others, subjected the Cælebogyne to strict and repeated examinations, but the result invariably was a confirmation of the case as stated by Smith. The Parthenogenesis of this plant was therefore generally accepted by the public of England; but on the Continent of Europe it was rejected,—as the observations of Treseinus on Datisca cannabina, of Lecogon Spinacia oleracea of Tenore, on Pistacia narbonensis, (confirmed by Bocconi on this and other species of Pistacia,) and of Ramisch on Mercurialis annua had already been. All these observations were regarded as mere delusions, of which science ought to be purged as speedily and completely as possibly; a fact which can take us the less by surprise when we reflect that the doctrine so ably and long maintained by the Horkelian school that the pollen contains the true origin of the embryo and that the ovulum is merely matrix—has only very recently become untenable through the experiments and observations of Hofmeister, Radlkofer and others.

It had been mentioned by Wenderoth and others that the monœcious Ricinus communis, the Castor Oil plant, produced ripe seed without the aid of pollen; but the direct observations of Naudin show that such is not the case, and that so far from exhibiting any tendency towards Parthenogenesis, all the female flowers fell off the moment the male ones were removed; a similar effect was produced on Esbalium elaterium, another monœcious plant, all the female flowers of which faded after the male ones of the same specimen were taken off: observations which justify us in considering as doubtful the existence of a Parthenogensis in monœcious plants, but which have established it in *nine* dioicious ones belonging to seven different natural orders.

The existence of a Parthenogenesis in animals and plants throws more light upon the history of the embryo than the most able and valued physiological researches could possibly do. It shows more clearly than the most lucid explanation, that the origin of the embryo has not to be looked for in the pollen of plants, or the semen

of animals, but in the ovula and ova themselves. And it is in this hin,t science recognizes the real practical utility of this great question. That the Parthenogenesis occupies an important office in the economy of nature we can already perceive, but how it comes to pass that the ova and ovula are developed without the aid of the male principle, and what means are employed to make a sexual reproduction, under such anomalous circumstances, possible, constitute one of those riddles, the solution of which is reserved for future investigation.

QUESTIONS CONNECTED WITH THE SALTNESS OF THE SEA.*—BY PROFESSOR CHAPMAN, OF UNIVERSITY COLLEGE, TORONTO.

It is a current opinion that, owing to the surface of the sea becoming salter and consequently heavier by evaporation, a downward motion of the surface water necessarily takes place; and hence Lieutenant Maury's hypothesis that the sea is salt in order to produce circulation. Some time ago I suggested another object in explanation of the saltness of the sea, viz.: that the sea is salt in order to regulate evaporation. The greater the amount of salt, the slower the evaporation of the water,—and the reverse; so that, if by any easily conceivable cause, or combination of circumstances, the normal degree of saltness become either increased or diminished—a kind of self-regulating force is set up to resist the continuation of the abnormal action, until time restore the balance. Even leaving out of consideration the equalizing effects produced by the accession of fresh water to the surface of the sea by rain and rivers, it seemed to me that the principle of diffusion was in itself sufficient to prevent the sinking of the water thus affected by evaporation; or, at least, to prevent the sinking of this water to any extent. But how to prove the point. The fact that the saltness of the open sea is substantially the same at considerable depths and at the surface, says nothing; as it would necessarily follow, that for every heavy particle of water that sunk, a lighter particle would rise up to supply its place; and hence the composition of the water would be kept uniform, without the principle of diffusion being in any way required to explain the phenomenon. After some consideration I adopted the following method, as one sufficiently trustworthy to afford an answer to the question under review:—I procured a leaden pipe one inch in diameter, and bent into the form of the letter U; each upright being about thirty-nine inches in height, and the connecting piece at the bottom rather more than twelve inches long. This I filled up to about an inch on each side with a solution of common salt in rain water (the salt being present to the amount of 3.786 per cent.,) and then I carefully closed one end, leaving the other end open, but protected from dust by a cone of silver-paper fixed on a bent wire, and so arranged as not to prevent evaporation. The per centage of salt (3.786) was carefully ascertained, and the apparatus left in an unoccupied room, the window and door of which were kept almost constantly open, in order to promote the evaporation of the solution as much as

* It is of course to be understood, that the term "Saltness of the sea," as here applied, has reference solely to the presence of a comparatively large amount of chloride of sodium in the water: to that principle, in fact, which constitutes the essential difference between the waters of the sea and those of lakes and rivers. The other saline substances present in variable proportions in sea-water, are present also, more or less, in bodies of fresh-water: and as they necessarily subserve the same general purposes in each case, their consideration does not legitimately belong to the present inquiry.

possible. After the lapse of about three months, (April 18 to July 14,) portions were taken from each end of the tube, and from the connecting piece below, (a small orifice being made in this;) and the amount of salt in each portion was accurately determined. Now, if the principle of diffusion had not been brought into play, it is evident that the solution in the open limb of the tube ought to have been stronger than that in the closed limb, although, by the circulating process, the amount of salt at the top and bottom of the former might have been alike; and, again, it will be equally evident that if the principle of diffusion were brought into play, the supposed sinking of the surface solution, as the result of evaporation, must be altogether imaginary. Six separate determinations, two from each of the three portions of the tube, shewed a per centage of salt essentially the same. The following table exhibits the results obtained:

		Solution.	Am. of Salt.	Per ct'ge of salt.
1	A. From the top of the open limb.	302.261..	11.59...	3.830
	B. From the bottom of the same........	300.24...	11.51...	3.835
	C. From the top of the closed limb......	288.60...	11.055..	3.831
2	A. From the top of the open limb......	264.83...	10.16...	3.837
	B. From the bottom of the same.......	290.10...	11.12...	3.833
	C. From the top of the closed limb.....	306.66...	11.75...	3.832

These experiments justify us, I think, in assuming that owing to diffusion, the surface waters of the sea do not become heavier than the lower strata simply by losing water by evaporation. It is quite true, that under the influence of evaporation a lowering of temperature may take place, and that an upward and downward circulation, to a certain extent, may in this manner be produced*; but the same reasoning will apply, and with equal force, to bodies of fresh water. In conclusion, therefore, I feel justified in expressing my sustained belief, that the theory which I have proposed to account for the saltness of the sea, is worthy of acceptance; this theory being that the sea is salt, essentially if not principally, in order to regulate evaporation.

NOTE.—Through the courtesy of various members of the American Association for the Advancement of Science, we have been favoured with abstracts of their papers, authenticated and revised reports, or, in some cases, with the loan of the original papers as submitted to the meeting in the different sections. We shall accordingly continue our report of the Montreal meeting in the next number, and endeavour to furnish a succinct embodiment of some of the most important contributions to science, presented at the first American Scientific Congress held within our Canadian frontier.

The January number of the Journal will also contain such a selection as our limited space will allow, from the numerous and valuable communications laid before the various sections during the recent meeting of the British Association for the Advancement of Science, at Dublin.

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* It should be stated that no intermixture could have taken place in the closed limb of the apparatus described above by ascending currents produced by unequal temperature, as the temperature of the lower portion of the closed tube was kept purposely lower (or at least prevented from becoming higher) than the upper portion by means of a damp rag permanently attached to it.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—AUGUST, 1857.

Latitude—43 deg. 39.4 min. North. Longitude—79 deg. 21 min. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Mean Temp. + or — of the Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN	6 A.M	2 P.M	10PM	ME'N		6 A.M	2 P.M	10 P.M	M'N	6 A.M	2 P.M	10 P.M	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M	2 P.M	10PM	Re-sult	ME'N		
1	29.488	29.466	29.508	29.4872	°57.7	°74.3	°63.0	°65.60	° — 1.37	.412	.518	.399	.437	.88	.63	.71	.72	W N W	W b N	N W	N °76 W	3.0	12.0	6.8	4.84	5.62	......	...
2	.546	.554	—	—	57.7	74.7	—	—	—	.371	.508	—	—	.79	.61	—	—	W b S	S b W	N W	S 86 W	1.5	8.8	2.0	3.31	4.74	......	...
3	.642	.625	.601	.6212	57.5	76.1	66.2	68.20	+ 1.35	.395	.528	.509	.483	.86	.60	.81	.73	N W	S	E b N	S 57 W	2.4	6.0	4.8	2.27	4.35	......	...
4	.553	.507	.527	.5317	61.8	74.6	67.1	68.60	+ 1.80	.475	.617	.540	.555	.89	.74	.84	.82	N E	S b W	N b W	N 14 W	4.5	5.1	9.6	5.19	6.70	0.020	...
5	.573	.575	.627	.5933	60.3	75.2	62.1	66.85	+ 0.03	.420	.376	.396	.395	.81	.44	.73	.64	N b W	N N W	N N W	N 15 W	9.5	10.8	7.0	4.02	7.82	......	...
6	.701	.716	.747	.7248	60 3	74.8	62.8	66.58	— 0.18	.383	.550	.477	.468	.75	.66	.87	.74	W N W	S	E	N 63 E	1.8	0.2	2.8	1.95	2.87	......	...
7	.761	.761	.783	.7560	62.1	78.7	66.2	69.80	+ 3.12	.430	.513	.563	.519	.78	.54	.91	.75	N N E	S E b S	Calm.	S 64 E	3.0	5.5	0.0	2.51	2.85	......	...
8	.728	.706	.760	.7340	67.5	82.2	68.6	73.68	+ 7.02	.580	.642	.458	.530	.89	.60	.67	.67	Calm.	S b W	N N W	N 25 W	0.0	6.4	10.5	5.04	7.94	Inap	...
9	.821	.746	—	—	64.8	73.1	—	—	—	.394	.550	—	—	.66	.69	—	—	N E b N	S S E	E b S	N 83 E	6.2	5.6	2.2	3.99	4.97	......	...
10	.466	.343	.303	.3617	62.9	71.9	64.4	67.43	+ 0.92	.442	.565	.440	.511	.78	.74	75	.77	N N E	S W b S	NW b N	S 83 W	5 0	13.5	6.5	2.33	5.37	......	...
11	.368	.444	.525	.4568	62.4	74.2	60.3	65.30	— 1.13	.482	.366	.260	.367	.88	.44	.52	.61	NW b W	W N W	N N W	N 35 W	6.0	9.8	2.0	6.60	7.17	......	...
12	.650	.580	.523	.5745	56.3	64.0	67.3	63.25	— 3.08	.328	.540	.609	.512	.74	.93	.93	.89	N	E b N	E N E	N 61 E	4.0	8.5	5.2	2.44	5.20	0.890	...
13	.497	.434	.465	.4520	70.6	85.3	74.0	76.88	+10.15	.631	.744	.678	.698	.87	.63	.84	.80	S W	W S W	SW b S	S 42 W	7.0	18.0	6.4	9.20	9.57	......	...
14	.480	.419	.494	.4817	72.3	78.1	64.0	70.17	+ 3.93	.669	.755	.434	.601	.87	.31	.75	.82	S W	S W b S	W N W	N 73 W	4.2	12.4	5.5	4.45	6.89	0.840	...
15	.584	.592	.685	.6280	55.9	70.7	59.2	62.78	— 3.37	.372	.489	.334	.402	.85	.67	.67	.71	NW b W	S b W	N N W	N 44 W	6 0	7.9	10.4	4.81	7.58	......	...
16	.802	.781	—	—	57.4	66.0	—	—	—	.333	.319	—	—	.73	.52	—	—	N	E b N	NE b E	N 70 E	5.0	8.5	6.4	7.66	8.11	1.110	...
17	.535	.604	.671	.6070	57.4	60.3	61.0	59.43	— 6.53	.407	.445	.491	.445	.88	.87	.94	.90	N E	E N E	N b W	N 22 E	16.5	4.0	3.0	5.78	6.23	0.275	...
18	.685	.677	.669	.6783	57.8	66.0	58.4	61.92	— 3.92	.387	.406	.385	.392	.82	.65	.81	.73	N	S E b S	S S E	S 46 E	5.5	9.0	1.0	2.41	4.42	0.240	...
19	.645	.610	.631	.6453	56.6	68.9	57.2	61.63	— 4.13	.416	.534	.378	.454	.92	.78	.83	.84	N N E	S S W	W b N	N 76 W	1.5	8.5	4.0	6.05	7.07	0.055	...
20	.738	.743	.772	.7533	55.1	70.0	65.7	62.97	— 2.58	.350	.284	.461	.347	.82	.40	.74	.64	NW b W	W N W	N N W	N 41 W	3.4	11.2	5.2	7.52	7.87	......	...
21	.826	.761	.648	.7513	51.9	68.2	60.6	61.18	—4.25	.333	.397	.461	.406	.87	.59	.88	.77	N N W	S E b E	E S E	S 46 E	4.0	5.0	8.5	5.51	7.24	0.125	...
22	479	.293	.237	.3270	62.4	68.6	51.9	63.95	— 1.40	.453	.516	.459	.476	.82	.76	.85	.82	S E	S b W	S W b S	S 5 W	13.0	14.5	5.4	8.82	10.05	0.145	...
23	.244	.226	—	—	58.3	60.6	—	—	—	.397	.443	—	—	.83	.85	—	—	S W	S W b S	N W	N 75 W	6.2	8.0	16.0	10.63	12.92	0.150	...
24	.607	.701	.769	7013	50.1	64.4	56.6	57.93	— 7.02	.306	.369	.375	.353	.86	.63	.84	.76	W N W	S S W	S W	S 67 W	5.8	9.8	4 7	4.33	5.67	......	...
25	.836	.819	.821	.8292	53.4	71.6	61.7	63.35	— 1.88	.366	.527	.423	.448	.91	.71	.78	.79	W S W	S b W	S W	S 25 W	3.0	13.0	2.8	5.74	5.87	......	...
26	.847	.778	.696	.7675	53.5	73.6	62 4	64.33	— 0.20	.372	.401	.447	.436	.93	.50	.82	.76	Calm.	S E	N E b E	E	0 0	4.0	2.5	2.96	3.52	......	...
27	.622	.436	.179	.3915	63.1	70.7	65.7	67.52	+ 3.20	.491	.622	.583	.568	.87	.85	.95	.87	N E b E	E b S	S	S 23 E	3.2	3.4	13.0	3.84	4.73	0.915	...
28	.193	.286	.383	.2938	61.7	70.6	59.5	65.62	+ 1.48	.490	.555	.449	.492	.91	.77	.90	.84	SW b S	S b W	SW b W	S 63 W	3.0	7.4	3.2	5.34	6.27	0.500	...
29	.424	.477	.601	.5092	56.6	66.4	55.9	60.18	— 3.63	.411	.415	.354	.396	.92	.65	.81	.78	S W	NW b N	NW b N	N 36 W	0.5	7.5	5.0	3.25	8.48	......	...
30	.678	.677	—	—	50.7	66.9	—	—	—	.322	.484	—	—	.88	.75	—	—	N W	S W b S	W b S	S 67 W	2.7	7.5	3.5	4.25	4.83	......	...
31	.784	.794	.813	8032	57.0	71.5	60.3	63.55	+ 0.23	.400	.472	.458	.454	.88	.64	.89	.80	W S W	S W	Calm.	S 42 W	1.0	8.2	0.0	4.17	4.30	......	...
M	29.6043	29.5826	29.5938	29.5943	59.40	71.96	62.75	65.31	— 0.45	.431	.506	.455	.467	.86	.66	.81	.77	....	....	....	....	4.46	8.39	5.35	......	6.36	5.265	...

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR AUGUST, 1857.

Highest Barometer . . . . 29.860 at 8 a.m. on 25th } Monthly range=
Lowest Barometer . . . . 29.155 at midnt on 27th } 0.705 inches.

Self-register-ing Ther.
- Maximum temperature . . . . 88°2 on p. m. of 13th } Monthly range=
- Minimum temperature . . . . 46.0 on a. m. of 24th } 42°2
- Mean maximum temperature . . 74°45 } Mean daily range = 19°50
- Mean minimum temperature . . 54°95 }
- Greatest daily range . . . . 28°0 from 14th p. m. to 15th a. m.
- Least daily range . . . . 6.7 from p. m. of 17th to a. m. of 18th.

Warmest day . . 13th ... Mean Temperature . . . 76°38 } Difference=18°45.
Coldest day . . . . 24th ... Mean Temperature . . . 57.93 }

Maximum. { Solar . . . . 101°5 on p. m. of 15th } Monthly range=
Radiation. { Terrestrial . . . . . . 34.0 on a. m. of 24th } 67°5

Aurora observed on 1 night, viz.: 26th at 9.30 p.m, (faint); possible to see Aurora on 22 nights; impossible to see Aurora on 9 nights.

Raining on 13 days; depth, 5.265 inches; duration of fall, 67.3 hours.

Mean of cloudiness=0.47; most cloudy hour observed, 6 a. m., mean=0.55: least cloudy hour observed, 10 p. m.; mean=0.35.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
1712.96	1465.83	914.04	2007.33

Resultant direction of the wind, N 77° W; Resultant Velocity, 1.51 miles per hour.

Mean velocity of the wind 6.36 miles per hour.
Maximum velocity . . . 26.6 miles per hour, from 5 to 6 p. m. of 23rd.

Most windy day . . . . 23rd—Mean velocity, 12.92 miles per hour.
Least windy day . . . . 7th—Mean velocity, 2.85 do

Most windy hour 4 to 5 p.m.—Mean velocity, 9.23 do } Difference
Least windy hour 4 to 5 a. m.—Mean velocity, 4.34 do } 4.89 miles.

Thunderstorms occurred on the 12th from 8.30 to 11.30 p.m.—14th from 2.10 to 3.30 p.m.—22nd from 3 to 7 p.m.—27th 6 to 7.15 p.m.—and on 28th from 5.30 p.m. continuing with a few intermissions.

Distant Thunder heard on the 1st at 3 p.m. and Sheet Lightning observed on the 10th from 8.30 p.m.

Heavy Dew recorded on the mornings of the 2nd 4th 10th 16th 20th 21st and 30th.

Rainbows observed on the 23rd at 5.30 p.m. (imperfect) and on the 28th at 6.30 p.m., double, and very perfectly defined.

Meteors numerous on the nights of the 10th 11th and 13th—a very brilliant meteor observed on the 31st at 11.10 p.m. in the South, passing from W. to E.

Slight hoar Frost reported to have been observed on the morning of the 24th.

Rain—The rain that fell this month was nearly twice the average. Its depth was never exceeded but in 1841 when the depth recorded was 6.170 inches.

Wind—The resultant direction for August from 1848 to 1857 inclusive was N62°W and the resultant velocity 0.68 miles per hour.

COMPARATIVE TABLE FOR AUGUST.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	No. of days.	Inches.	No. of days.	Inches.	Resultant Direction.	Resultant Velocity.	Mean Velocity
1840	64.7	— 1.3	80.1	47.4	32.7	12	2.905	...	...	—	—	—
1841	64.4	— 1.6	83.5	46.7	36.8	9	6.170	...	...	—	—	0.19 lbs
1842	65.7	— 0.3	80.7	45.3	35.4	6	2.500	...	...	—	—	0.30 "
1843	66.4	+ 0.4	85.5	44.4	41.1	4	4.850	...	...	—	—	0.12 "
1844	64.3	— 1.7	82.5	44.3	38.2	17	imp.	...	...	—	—	0.16 "
1845	67.9	+ 1.9	82.5	44.4	38.1	9	1.725	...	...	—	—	0.19 "
1846	68.4	+ 2.4	86.3	50.4	35.9	9	1.770	...	...	—	—	0.17 "
1847	65.1	— 0.9	83.1	44.9	38.2	10	2.140	...	...	—	—	0.19 "
1848	69.2	+ 3.2	87.5	49.3	38.2	8	0.855	...	...	S 21 E	0.93	3.55mls
1849	66.3	+ 0.3	79.5	51.4	28.1	10	4.970	...	...	N 71 W	0.60	3.76 "
1850	66.8	+ 0.8	84.2	43.0	41.2	13	4.355	...	...	N 15 E	0.55	4.46 "
1851	63.6	— 2.4	79.8	43.6	36.2	10	1.360	...	...	N 63 W	0.40	4.62 "
1852	65.9	— 0.1	81.2	46.7	34.5	9	2.695	...	...	N 70 E	0.56	3.50 "
1853	68.6	+ 2.6	91.6	47.6	44.0	11	2.575	...	...	S 29 E	0.37	4.23 "
1854	68.0	+ 2.0	98.1	47.0	51.1	5	0.455	...	...	N 62 W	1.74	4.74 "
1855	64.1	— 1.9	82.1	44.9	37.2	7	1.455	...	...	N 63 W	1.04	5.97 "
1856	63.6	— 2.4	81.3	44.0	37.3	12	1.680	...	...	N 50 W	2.88	7.03 "
1857	65.3	— 0.7	85.3	50.1	35.2	13	5.265	...	...	N 77 W	1.51	6.36 "
Mean	66.02	...	84.15	46.41	37.74	9.7	2.807	...	...	—	—	5.00

MONTHLY METEOROLOGICAL REGISTER AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—SEPTEMBER, 1857.

Latitude—43 deg. 39.4 min. North. Longitude—79 deg. 21 min. West. Elevation above Lake Ontario, 108 *feet.*

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Mean Temp. + or — of the Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Result't. Direc-tion.	Direction of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M	2 P.M	10PM	ME'N		6 A.M	2 P.M	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.		6 AM.	2 PM.	10 P.M.	Re-sult'.	ME'N		
1	29.911	29.979	29.907	29.9185	°54.5	°75.8	°61.4	°65.30	+ °2.27	.378	.569	.488	.488	.91	.66	.91	.81	Calm.	s w b s	Calm.	s °34 w	0.0	5.0	0.0	2.16	2.16	...	...
2	.917	.905	.920	.9145	58.8	74.3	65.0	66.67	+ 3.93	449	589	529	527	92	72	88	83	s w b s	s s E	E	s 85 E	3.5	3.2	5.2	1.32	2.71	...	...
3	.962	.935	.926	.9395	60.8	74.1	66.2	67.48	+ 5.00	478	525	477	496	91	64	76	77	N b E	E	E b N	N 7[illegible] E	1.0	6.0	4.0	2.26	3.19	...	...
4	.931	.866	.795	.8523	61.7	76.1	63.5	67.83	+ 5.70	467	610	486	528	87	70	85	80	Calm.	s s w	Calm.	s 65 E	0.0	1.0	0.0	0.50	0.58	...	...
5	.741	.606	.730	.7012	60.6	74.9	60.3	65.25	+ 3.42	413	611	417	515	80	73	81	83	Calm.	s w	N b w	N 74 w	0.0	8.4	12.0	3.68	5.97	1.213	...
6	.910	.919	—	—	50.7	65.3	—	—	—	312	225	—	—	86	27	—	—	N	w N w	N N w	N 51 w	0.8	4.4	4.5	3.41	5.9[illegible]	...	...
7	30.043	30.068	30.027	30.0423	50.7	59.6	49.6	54.75	— 6.40	285	250	266	265	79	50	77	64	N b w	s E b s	Calm.	s 62 E	4.0	5.0	0.0	2.54	3.[illegible]	...	...
8	30.017	29.920	29.854	29.9178	45.4	66.8	54.1	57.30	— 3.43	262	332	362	341	88	52	88	75	s s E	s s w	Calm.	s 22 w	1.2	3.6	0.0	1.51	1.5[illegible]	...	...
9	29.849	.753	.677	.7520	51.6	71.1	59.2	61.18	+ 0.83	318	484	460	423	84	65	93	80	Calm.	s w b s	Calm.	s [illegible]0 w	0.0	2.2	0.0	1.03	1.03	...	...
10	.638	.550	.565	.5842	56.3	78.0	67.8	68.60	+ 8.55	403	621	585	558	91	67	89	82	Calm.	s w	Calm.	s 45 w	0.0	14.0	0.0	5.55	5.59	...	...
11	.661	.580	.662	.6160	65.4	81.4	64.8	70.92	+11.27	554	744	518	601	91	71	87	81	Calm.	s w	E N E	s 80 E	0.0	11.8	12.0	1.38	7.69	0.002	...
12	.683	.628	.583	.6278	61.1	66.0	61.7	63.45	+ 4.22	456	518	518	499	87	34	93	89	E N E	E N E	Calm.	N 83 E	6.0	3.8	0.0	2.63	2.72	...	...
13	.576	.542	—	—	60.6	74.0	—	—	—	483	577	—	—	94	71	—	—	Calm.	E b s	E N E	s 88 E	0.0	5.5	0.8	1.74	1.99	...	...
14	.525	.418	.576	.5215	65.3	74.9	62.4	67.42	+ 9.08	566	677	392	559	93	81	72	84	Calm.	s b E	N w	N 56 w	0.0	4.0	10.4	5.74	6.60	0.135	...
15	.681	.745	.834	.7590	54.5	67.6	55.2	59.63	+ 1.72	350	301	325	329	84	45	76	68	N w b w	N w b N	N N w	N 35 w	10.5	12.4	6.5	9.87	10.23	...	...
16	.847	.781	.622	.7387	50.5	60.3	60.4	57.75	+ 0.23	302	333	394	361	84	65	78	73	N b w	s E b E	s E b s	s 56 E	3.0	2.0	5.0	3.91	4.67	0.225	...
17	.381	.248	.495	.3822	59.9	71.8	58.8	63.80	+ 6.80	469	664	422	512	92	88	87	88	s E	w s w	N w b w	N 50 w	3.3	12.0	3.5	6.52	8.04	0.215	...
18	.645	.748	.803	.7445	52.1	56.3	49.0	52.15	— 4.47	293	260	255	275	77	59	74	72	N b w	N E	N b E	N 20 E	18.0	6.0	5.6	7.24	8.70	...	...
19	.764	.642	.499	.6230	46.5	51.4	49.8	48.27	— 7.85	266	281	309	273	85	75	88	82	N E	E N E	N N w	N 56 E	11.5	13.2	10.1	9.38	10.70	0.430	...
20	.567	.657	—	—	46.5	56.6	—	—	—	257	375	—	—	82	83	—	—	N b w	N w	N w b N	N 27 w	4.5	7.2	5.0	6.48	6.67	...	...
21	.806	.768	.686	.7478	41.5	57.6	56.3	52.87	— 2.25	218	255	316	277	84	55	71	70	N b w	s E	E s E	s 45 E	4.5	5.4	11.0	4.48	5.37	...	...
22	.525	.410	.442	.4455	54.6	58.1	44.3	52.45	— 2.13	327	367	247	307	78	77	86	79	s E b s	s w	N w b w	N 87 w	7.0	6.8	13.2	4.99	6.67	0.210	...
23	494	.457	.496	.4850	41.1	51.9	50.3	48.63	— 5.58	218	286	260	248	85	75	72	73	w b N	N w b w	s w b w	s 74 w	2.4	6.6	5.1	7.13	7.27	0.015	...
24	.575	.568	.617	.5945	46.2	66.1	56.3	56.25	+ 2.50	279	434	387	375	90	70	87	84	w s w	s	s w b s	s 20 w	4.5	10.2	2.2	5.42	5.62	...	...
25	.674	.612	.654	.6490	52.3	68.8	59.3	61.52	+ 8.28	334	497	395	411	87	73	80	77	Calm.	s b w	s s w	s 29 w	0.0	14.0	2.5	5.08	6.56	...	...
26	.772	.836	.797	.8055	54.8	65.0	51.6	57.50	+ 4.77	332	422	343	364	79	71	91	79	N w	s b w	s b w	s 15 w	5.0	3.8	1.8	1.32	3.27	...	...
27	.754	.611	—	—	49.8	72.6	—	—	—	333	536	—	—	94	69	—	—	s b E	s s w	N w b w	s 45 w	3.0	13.0	7.2	5.85	7.52	0.100	...
28	.545	.534	.725	.6107	56.3	55.2	45.3	52.63	+ 0.80	387	328	219	309	87	77	73	78	s w	w b N	N w b N	N 78 w	3.8	19.2	9.0	12.31	13.1[illegible]	0.085	...
29	.778	.821	.816	.7960	39.3	47.6	37.1	41.32	—10.00	207	145	177	178	87	44	80	71	w N w	N N w	Calm.	N 37 w	6.1	17.8	0.0	6.86	7.09	...	...
30	.756	.719	.757	.7432	39.5	52.5	38.4	43.73	— 7.08	180	199	192	195	75	51	83	71	w b s	w N w	Calm.	N 73 w	0.4	16.5	0.0	4.57	4.69	0.010	...
M	29.7331	29.6960	29.7102	29.7120	53.13	65.51	55.70	58.64	+ 1.15	.353	.435	.375	.393	.86	.67	.83	.78	....	....	....	....	3.47	8.07	4.49	....	5.55	2.640	

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR SEPTEMBER.

Highest Barometer........................ 30.076 at 8 a. m., on 7th } Monthly range=
Lowest Barometer .... 29.248 at 2 p. m., on 17th } 0.828

Self-regist'ing Thermom. {
Maximum Temperature...............82°.0 on p. m., of 11th } Monthly range=
Minimum Temperature...............34°.1 at midt. of 29th } 47.°9
Mean maximum Temperature .... 67°48 } Mean daily range=
Mean minimum Temperature .... 48°14 } 19.34
Greatest daily range ....28°5 from p. m. of 5th to a. m. of 6th.
Least daily range.................. 7°0 from p. m. of 12th to a. m. of 13th.

Warmest day......... 11th ... Mean temperature......... 70°92 } Difference = 29°60.
Coldest day......... 29th ... Mean temperature......... 41.32 }

Maximum { Solar.................................. 98°0 on p. m. of 4th, } Monthly range=
Radiation. { Terrestrial.......................... 23°5 on a. m. of 29th. } 74°5

Aurora observed on 6 nights, viz., 3rd, 10th, 14th, 23rd, 25th and 29th.
Possible to see Aurora on 21 nights; impossible on 9 nights.

Raining on 11 days,—depth 2.640 inches; duration of fall 31.9 hours.

Mean of cloudiness = 0.43.
Most cloudy hour observed, 2 p. m., mean = 0.49; least cloudy hour observed, 10 p. m., mean, =0.30.

Sums of the components of the Atmospheric Current, expressed in miles.

North.	South.	East.	West.
1536.94	1111.19	721.52	1797.17

Resultant direction N. 68° W.; Resultant Velocity 1.61 miles per hour.
Mean velocity.......................... 5.55 miles per hour.
Maximum velocity .... 23.1 miles from 11 a. m. to noon on the 28th.
Most windy day......................... 28th...Mean velocity 13.11 miles per hour.
Least windy day .... 4th...Mean velocity 0.58 ditto.
Most windy hour ... 3 to 4 p. m.............Mean velocity 9.27 ditto. } Difference
Least windy hour ... 6 to 7 a. m.............Mean velocity 3.47 ditto. } 5.80 miles.

Corona round the Moon on 1st at midnight, 3rd at midnight, 4th at 10 p.m., 5th from 10 p.m. and 7th from 10 p.m.

Halo round the Moon on 9th at midnight, and round the Sun on 21st, from 9.30 to 1 p.m.

Dense Fog on 5th at 6 a.m., 12th from 4.40 p.m., and on 13th at 6 a.m.

Heavy Dew very frequent, having been recorded on 15 days during the month

Hoar Frost on 21st, at 5.40 a.m., and on 30th at 1 a.m.

Hail Shower on 28th at 0.10 p.m., and on 30th at 2 p.m.

Rainbow on 28th, at 2.20 p.m., very perfect.

Thunderstorm on 5th from 1.40 to 4 p.m., and on 11th at 5.30 p.m.

Sheet Lightning on 13th from 6.50 p.m., 25th from 7 to 9 p.m., and on 27th during the evening.

Wind.—The resultant direction of the wind for September, from 1848 to 1857 inclusive, was N. 54° W., and the resultant velocity 0.93 miles per hour.

Rain.—The depth of rain was 1.693 inches less than the average of 17 years.

COMPARATIVE TABLE FOR SEPTEMBER.

Year.	Temperature.					Rain.		Snow.		Wind.		
	M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range.	No. of days.	Inch's.	No. of days.	Inch's.	Resultant. Direction.	Resultant. V'y.	Mean Force or Velocity.
	°	°	°	°	°							
1840	54.0	—4.1	70.2	29.4	40.8	4	1.380	...	...	...	...	....
1841	61.3	+3.2	79.9	37.5	42.4	9	3.340	...	...	...	...	0.26 lbs.
1842	55.7	—2.4	83.5	28.3	55.2	12	6.160	...	...	...	...	0.45
1843	59.1	+1.0	87.8	33.1	54.7	10	9.760	...	...	...	...	0.57
1844	58.6	+0.5	81.5	29.6	51.9	4	....	...	...	...	...	0.26
1845	56.0	—2.1	78.8	35.3	43.5	16	6.245	...	...	...	...	0.34
1846	63.6	+5.5	84.0	39.0	45.0	11	4.595	...	...	...	...	0.33
1847	55.6	—2.5	74.8	38.1	36.7	15	6.665	...	...	...	...	0.33
1848	54.2	—3.9	80.9	29.5	51.4	11	3.115	...	...	N 71° W	2.38	5.81 mls.
1849	58.2	+0.1	80.6	33.5	47.1	9	1.480	...	...	N 75° W	0.69	4.23
1850	56.5	—1.6	76.0	31.7	44.3	11	1.735	...	...	S 65° W	1.02	4.78
1851	60.0	+1.9	86.3	33.4	52.9	9	2.665	...	...	N 14° E	1.03	5.45
1852	57.5	—0.6	81.8	36.1	45.7	10	3.630	...	...	N 77° W	0.53	4.60
1853	58.8	+0.7	85.4	36.1	49.3	12	5.140	...	...	N 5° E	1.05	4.30
1854	61.0	+2.9	93.1	36.3	56.8	14	5.375	...	...	N 23° W	1.42	4.31
1855	59.5	+1.4	81.7	36.1	45.6	12	5.585	...	...	N 20° E	1.29	7.61
1856	57.1	—1.0	77.3	37.4	39.9	13	4.150	...	...	S 79° W	1.98	6.53
1857	58.6	+0.5	81.4	34.1	47.3	11	2.640	...	...	N 68° W	1.61	5.55
M	58.07	...	81.39	34.14	47.25	10.7	4.333	...	...	...	...	5.32miles.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—AUGUST, 1857.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL. D.

Latitude—45 deg. 32 min. North. Longitude—73 deg, 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32° Fahr.			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Velocity in miles per hour.			Mean direction of Wind.	Rain in Inches.	Snow in Inches.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A. M.	2 P. M.	10 P. M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 PM	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 PM				6 A.M.	2 P.M.	10 P.M.
1	29.569	29.533	29.655	62.7	66.6	60.6	.528	.516	.511	.93	.80	.93	s w	w s w	s w b s	7.22	2.96	1.11	...	0.540	...	Cir. Str. 10.	Ni. 10.	C. St. 2. Thund.
2	.614	.620	.798	60.0	76.7	65.6	.512	.692	.586	.96	.78	.93	s w b s	s w b s	s w b s	0.22	1.42	2.16	...	Inapp	...	Do. 7.	C. C. Str. 6.	C. C. Str. 2.
3	.734	.700	.898	62.2	81.0	68.8	.528	739	.634	.93	.71	.90	s E	s by E	SE b E	0.12	0.18	0.40	...	...	...	Clear.	C. St. 4.	C. St. 3.
4	.754	.712	.678	66.1	87.7	70.6	.574	.814	.541	.89	.65	.74	s s w	s s w	N N w	0.00	0.35	0.30	...	...	...	Do.	Do. 2.	Do. 10.
5	.643	.700	.726	63.2	87.9	62.5	.461	.801	.499	.29	.62	.89	N b E	N b E	NW b w	6.57	3.06	4.65	...	...	...	C. Str. 10.	Do, 2.	Clear.
6	.812	.835	.949	59.6	86.0	59.0	.478	.648	.452	.90	.53	.89	E N E	E by N	s E	3.16	2.08	0.10	...	...	...	Clear.	Clear.	Do.
7	.967	.915	.999	56.5	88.1	68.0	.488	.692	.582	.89	.53	.85	s s w	s w	s b E	0.48	0.43	0.10	...	...	...	Do.	Do.	C. Str. 2.
8	.848	.749	.891	64.4	83.0	64.0	.565	.715	.476	.93	.64	.79	s b w	w s w	w N w	6.66	7.21	8.77	...	...	...	C. Str. 10.	C. St. 9.	Clear.
9	.980	.970	.846	55.6	72.5	58.0	.552	.498	.437	.79	.64	.89	w	N E	s s w	9.75	4.87	0.21	...	...	...	Clear.	Clear.	Str. 2.
10	.685	.552	.491	58.0	79.2	64.2	.462	.659	.565	.90	.67	.63	s s E	s by E	sw b s	0.00	1.90	1.16	...	Inapp	...	C. C. Str. 6.	C. C. St, 8.	C. S. 10. D. Thun.
11	.857	.468	.596	62.6	70.3	62.0	.528	.541	.499	.93	.74	.89	w	N w	N b w	1.30	6.31	3.93	...	0.274	...	Cir. Str. 10.	C. Str. 4.	Do. 6. Dis. Thun.
12	.696	.700	.724	48.1	78.0	64.0	.334	.607	.504	.93	.64	.84	w b s	s s w	s E	0.36	0.40	2.60	...	...	...	Clear.	Clear.	Do. 2.
13	.676	.512	.446	63.0	70.0	63.0	.546	.659	.546	.94	.89	.94	s s E	N E	N E	3.71	1.40	1.42	...	1.079	...	Ni. 10.	C. St. 9.	Do. 10.
14	.417	.524	.551	67.0	84.0	67.3	.626	.854	.593	.93	.74	.89	w by s	N N w	w N w	1.05	5.50	9.65	...	...	...	C. Str. 10.	Do. 6.	Clear.
15	.641	.714	.830	65.0	76 0	58.0	.529	.659	.437	.85	.74	.89	N b w	w	NW b w	0.21	5.63	8.27	...	...	...	Do. 6.	Clear.	Do.
16	.858	.778	30.005	55.0	76.0	57.2	.372	.559	.376	.84	.74	.76	w b N	w b s	w	0.40	9.52	5.93	...	...	...	Clear.	St. 2.	C. St. 8.
17	.811	.746	29.688	48.7	68.0	49.6	.366	.552	.326	.92	.81	.88	N	NE by E	w b N	0.20	3.17	4.12	...	...	...	C. C. Str. 6.	Clear.	Cirr. Str. 4.
18	.813	.741	.764	47.0	72.0	54.7	.313	.578	.373	.92	.74	.87	NE by E	N E	N E	0.00	0.09	0.86	...	...	...	Do. 4.	C. C. Str. 8.	Clear.
19	.801	.714	.817	47.0	74.1	57.1	.313	.648	.378	.93	.78	84	s	s	s b E	1.32	1.15	1.25	...	...	...	C. Str. 2.	C. St. 10.	Ni. 10.
20	.806	.672	.856	67.4	73.0	58.9	.447	.692	.478	.94	.86	.92	N E	s w	s w	2.11	0.37	1.40	...	1.200	...	Ni. 10.	Do. 6.	C. St. 2.
21	.917	.915	.954	61.0	76.6	60.6	.520	.597	.441	.96	.67	.84	s w b s	s E	s b E	0.13	0.17	0.86	...	...	...	C. Str. 8.	C. C. St. 4.	Clear.
22	.817	.720	.666	55.6	72.1	61.0	.418	.578	.483	.93	.74	.89	s s E	s b E	s E	0.28	5.91	9.51	...	Inapp	...	C. Str. 10.	C. St. 6.	C. Str. 10.
23	.517	.358	.404	57.4	71.6	61.0	.447	.681	.512	.93	.89	.96	E s E	s b E	s s w	8.61	8.25	0.22	...	0.473	...	Cirr. 4.	Do. 4.	Clear.
24	.527	.511	.783	53.2	63.5	51.1	.311	.546	.337	.87	.93	.87	w	w b N	sw b w	7.78	10.55	9.43	...	Inapp	...	C. Str. 6.	C. C. St. 6.	Do.
25	.928	.868	.992	55.0	78.9	65.0	.396	.670	.555	.89	.71	.89	w b s	s w	s w	0.05	3.27	3.70	...	...	...	Clear.	Clear.	Do.
26	.925	.900	.883	37.0	79.7	65.5	.449	.692	.555	.94	.71	.89	s s w	s s w	s s w	1.63	4.52	5.06	...	...	...	Do.	Do.	Do. Aur. Boreal.
27	.880	.736	.614	64.0	86.0	70.1	365	.910	.628	.93	.75	.86	s s E	s s E	s b E	0.02	0.63	9.30	...	...	...	Do.	C. C. St. 2.	C. St. 10.
28	.377	.344	.485	65.0	79.9	68.0	.589	.692	.613	.93	.71	.89	s by E	s w	s s w	22.25	7.10	8.00	...	1.023	...	C. Str. 10.	C. Str. 10.	Do. 4.
29	.504	.521	.624	66.0	68.0	60.0	.514	.590	.467	.89	.86	.89	s w b s	w	N w	2.18	7.63	4.65	...	Inapp	...	Do. 4.	Do. 8.	C. C. Str. 8.
30	.681	.679	.746	48.2	66.6	60.7	.302	.440	.417	.86	.68	.89	w b N	w by s	w s w	6.96	9.81	7.07	...	...	...	Do. 10.	Clear.	C. Str. 4.
31	.817	.883	30.052	60.1	73.6	50.6	.441	.568	.349	.84	.71	.92	w b N	s s E	s E	11.75	3.70	1.81	...	...	...	Do. 8.	C. St. 4.	Clear.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—SEPTEMBER, 1857.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32° 6 A.M.	2 P.M.	10 P.M.	Temp. of the Air. 6 A.M.	2 P.M.	10 P.M.	Tension of Vapor. 6 A.M.	2 P.M.	10 P.M.	Humidity of Air. 6 A.M.	2 P.M.	10 PM	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Velocity in miles per hour. 6 A.M.	2 P.M.	10 PM	Mean direction of Wind.	Rain in Inches.	Snow in Inches.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0. 6 A.M.	2 P.M.	10 P.M.
1	30.061	30.019	30.090	46.9	85.7	68.2	.282	.763	.582	.86	.65	.86	s w	s w	s w	0.20	5.61	3.06	...	...	...	Clear.	Clear.	Clear.
2	.049	29.974	.093	62.0	88.4	70.0	.471	.801	.628	.84	.62	.86	s w	s s w	s b w	1.46	1.72	0.30	...	...	...	Do.	Do.	Cir. Str. 2.
3	.099	30.076	.083	60.7	88.6	62.5	.511	.801	.540	.93	.62	.92	s b w	s b w	s b w	0.46	0.17	0.35	...	...	...	Fog.	Clear.	Clr. Au. Bor.
4	.081	.076	.003	63.5	91.4	68.2	.516	.814	.646	.89	.59	.93	s b w	s s E	s s E	0.15	0.05	0.00	...	...	...	Clear.	Do.	Cirr. 2.
5	29.861	29.701	29.691	69.8	81.2	65.7	.668	.704	.605	.92	.68	.93	s	s w	w N w	0.00	6.16	10.11	...	1.001	...	Do.	C. Str. 9.	C. Str. 8. T. S.
6	29.987	.935	30.031	51.2	63.3	46.6	.315	.307	.282	.81	.53	.86	N w	N w	N w	10.15	17.77	8.30	...	...	...	Str. 1.	Do. 2.	Clear.
7	30.160	30.135	.179	48.4	66.3	48.0	.281	.440	.302	.80	.68	.86	N w	s w	s	1.26	0.63	0.73	...	...	...	Clear, 1st Fr.	Str. 1.	Do.
8	.158	.035	29.959	54.0	69.1	60.9	.304	.437	.456	.89	.62	.84	w	w s w	s w	0.15	4.99	5.33	...	...	...	C. Str. 8.	Cirr. C. 4.	C. Str. 9. Thun
9	29.961	29.883	.905	58.2	69.0	62.4	.462	.570	.472	.92	.81	.84	w b s	N w	E s E	4.00	1.20	0.21	...	0.140	...	Do. 6.	C. Str. 10.	Clear. Light'g.
10	.837	.671	.598	60.4	81.6	73.0	.494	.739	.692	.91	.71	.86	E N E	w b s	w s w	0.26	15.22	3.96	...	0.133	...	Do. 10.	Clear.	Do. Au. Bo.
11	.451	.806	.925	70.0	58.0	54.6	.628	.437	.400	.86	.89	.92	w b s	N E b E	E b N	5.00	10.12	0.96	...	0.104	...	Do. 3.	Nimb. 10.	C. Str. 8.
12	.912	.814	.766	48.0	58.7	52.0	.302	.387	.349	.86	.79	.87	NE bye	N E	N E	6.78	8.12	12.05	...	Inp.	...	Do. 9.	C. Str. 8.	Do. 10.
13	.764	.609	.745	48.1	84.8	69.0	.281	.854	.634	.80	.75	.90	s E b E	s s w	s E b E	1.62	0.12	0.82	...	...	...	Clear.	Clear.	C. C. Str. 4.
14	.747	.712	.604	65.7	77.9	66.1	.586	.787	.605	.92	.86	.92	s s E	s s E	s s E	0.10	1.21	4.08	...	0.330	...	C. Str. 8.	C. Str. 2.	C. Str. 8. Ltg.
15	.680	.722	.900	59.5	67.5	52.9	.452	.480	.373	.89	.72	.92	w	w N w	N w b w	12.42	16.50	2.00	...	...	...	Do. 6.	Do. 2.	Clear.
16	.952	.885	.946	46.2	67.9	53.0	.282	.563	.361	.86	.85	.87	N	s b w	w s w	10.96	1.61	2.67	...	...	...	Clear.	Do. 4.	C. C. Str. 4.
17	.599	.453	.531	41.5	56.7	52.7	.235	.432	.386	.85	.94	.93	N w	w s w	w s w	0.22	0.10	0.35	...	0.140	...	Do.	Nimb. 10.	C. Str. 9.
18	.635	.975	.981	45.4	35.5	33.1	.253	.203	.187	.80	.91	.90	s b E	N w	N w	0.92	18.77	3.77	...	...	...	C. Str. 10,	Clear.	Clear.
19	.968	.908	.892	34.2	58.1	42.0	.170	.367	.243	.79	.75	.85	E	E s E	E	6.57	0.47	0.08	...	...	...	Clear.	C. C. Str. 8.	Do.
20	.694	.715	.901	44.0	50.9	41.7	.241	.326	.263	.79	.87	.92	E	N	sw b w	1.97	6.15	1.70	...	0.210	...	Nimb. 10.	Nimb. 10.	Do.
21	.980	.970	.999	37.7	57.8	42.9	.218	.422	.263	.91	.89	.92	s s E	E b N	E b s	0.00	0.50	0.07	...	...	...	Clear,	C. Str. 2.	Clear.
22	.847	.704	.581	44.7	50.5	49.2	.261	.349	.336	.85	.90	.93	s b E	s b E	s by E	0.86	2.27	10.32	...	0.720	...	C. Str. 7.	Nimb. 10.	Rain.
23	.500	.494	.604	40.2	51.4	44.9	.227	.255	.261	.85	.66	.85	w b N	w b N	w s w	15.87	19.48	9.42	...	0.170	...	Clear.	C. Str. 2.	Clear. Au. Bo.
24	.686	.712	.810	44.1	67.3	56.6	.282	.534	.432	.92	.81	.94	s w	w b s	s w	7.80	8.26	4.33	...	...	...	Do.	Do. 2.	Do.
25	.852	.819	.835	48.0	80.5	59.0	.291	.751	.452	.84	.75	.89	s	w s w	s b w	0.98	5.89	1.22	...	...	...	Do.	Clear.	Do. Au. Bor.
26	.861	.992	.954	57.1	72.5	54.1	.422	.450	349	.89	.58	.81	s w	w	w s w	1.52	6.90	3.71	...	...	...	Do.	Do.	Do.
27	.897	.762	.718	51.2	76.6	63.2	.361	.692	.516	.92	.78	.89	s b w	w b s	s b w	0.35	3.82	7.00	...	...	...	Do.	Do.	Do. Light'g.
28	.574	.580	.583	57.0	51.7	48.0	.447	.315	.324	.94	.81	.92	s w b s	w	s w	4.22	1.62	10.47	...	1.053	...	C. Str. 10.	Rain, Thun.	C. Str. 9.
29	.754	.759	.852	39.0	47.0	36.0	.214	.271	.192	.84	.80	.83	w N w	w b N	w	19.32	15.67	11.32	...	...	...	Clear.	C. Str. 6.	C. Lt. Snow.
30	.868	.840	.857	34.0	52.0	38.2	.186	.274	.226	.87	.70	.90	w N w	s w	s w b s	1.90	4.80	2.71	...	0.170	...	Do.	C. Str. 8.	C. Str. 6. A.B.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR AUGUST.

Barometer	Highest the 31st day	30.052
	Lowest the 28th day	29.344
	Monthly Mean	29.723
	Monthly Range	0.708
Thermometer	Highest the 7th day	90°4
	Lowest the 25th day	45°.2
	Monthly Mean	65°07
	Monthly Range	45°2

Greatest Intensity of the Sun's Rays .... 120°0

Lowest Point of Terrestrial Radiation .... 41°.4

Mean of Humidity .... .848

Amount of Evaporation .... 2.84 inches.

Rain fell on 11 days, amounting to 4.580 inches; it was raining 43 hours and 10 minutes and was accompanied by thunder on 3 days.

Most prevalent wind, S. W. Least prevalent wind, E. by N.

Most windy day, the 28th day; mean miles per hour, 12.45.

Least windy day, the 3rd day; mean miles per hour, 0.23.

The electrical state of the atmosphere has indicated rather feeble intensity.

Ozone was in large quantity.

Aurora Borealis visible on 1 night.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR SEPTEMBER.

Barometer	Highest, the 7th day	30.179
	Lowest, the 11th	29.451
	Monthly Mean	29.842
	Monthly Range	0.728
Thermometer	Highest, the 4th day	91°.4
	Lowest, the 19th day	30°.4
	Monthly Mean	57°47
	Monthly Range	61°0

Greatest intensity of the Sun's Rays .... 121°.2

Lowest point of Terestial Radiation .... 29°.8

Mean of Humidity .... .823

Amount of Evaporation .... 2.48 inches.

Rain fell on 11 days amounting to 4.171 inches; and was accompanied by thunder on three days, it was raining 45 hours 4 minutes.

A few flakes of snow fell on the 29th day, being the first this season.

The most prevalent wind was the W S W.

The least prevalent wind N.

The most windy day the 29th; mean miles per hour 15.43.

Least windy day the 21st; mean miles per hour 0.19.

The electrical state of the Atmosphere has indicated rather high intensity.

Ozone was in moderate quantity.

The Aurora Borealis visible on 5 nights.

INDEX.

DIRECTIONS TO THE BINDER.

THE

CANADIAN JOURNAL

OF

INDUSTRY, SCIENCE, AND ART:

CONDUCTED BY

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NOTICE.

TO THE MEMBERS OF THE CANADIAN INSTITUTE.

As this number completes another volume of the *Canadian Journal*, Members of the Institute will please remember that the Annual Subscription (*of $4 from members residing in Toronto and its vicinity, and $3 from country members,*) falls due on the 1st of January, when the first number of the next volume will be issued.

Members whose former subscriptions remain unpaid, are particularly requested to remit them without delay, as by failing to do so they materially impede the progress of the Institute.

THE JOURNAL CAN ONLY BE CONTINUED IN FUTURE TO MEMBERS NOT IN ARREARS.

CANADIAN INSTITUTE,
Toronto, November 1, 1857.

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